AF/ew

10/631,129

Docket Number 81131517 (19278)

PATENT

☒ **CERTIFICATE OF MAILING/TRANSMISSION (37 C.F.R. § 1.8(a))**

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Sept. 10, 2007 — Date

Paul K Godlewski — Signature

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Before The Board of Patent Appeals and Interferences

Appellants: Youngpeter, Bryan; et al

Serial No: 10/631,129

Filed: July 31, 2003

Group Art Unit: 3746

Examiner: Freay, Charles Grant

Title: Power Steering Pump Having Electronic ByPass Control

APPEAL BRIEF - Amended

Mail Stop Appeal Brief - Patents

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

This appeal is from a Final Rejection dated February 7, 2007. Notice of Appeal was filed on May 7, 2007.

This Appeal Brief – Amended is a substitute for the Brief that was filed on July 10, 2007 and for which a Notification of Non-Compliant Appeal Brief letter was issued on August 14, 2007. It is believed that all elements are in compliance with 37 CFR 41.37.

Authorization to charge the appropriate fee to a USPTO Deposit Account was submitted with the earlier Appeal Brief.

I. REAL PARTY IN INTEREST (37 C.F.R. § 41.37(c)(1)(i))

By assignment, the owner of the application is:

Automotive Components Holdings, LLC.
17000 Rotunda Drive,
Dearborn, Michigan 48120

II. RELATED APPEALS AND INTERFERENCES (37 C.F.R. § 41.37(c)(1)(ii))

There are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS (37 C.F.R. § 41.37(c)(1)(iii))

Claims in the application: 7-11

Claims cancelled: 1 - 6

Claims rejected: 7 -11

Claims being appealed: 7-11 (Copy in Claims Appendix)

IV. STATUS OF AMENDMENTS (37 C.F.R. § 41.37(c)(1)(iv))

There are no other outstanding amendments filed after the final rejection.

V. SUMMARY OF CLAIMED SUBJECT MATTER (37 C.F.R. § 41.37(c)(1)(v))

In general, the claims are directed to a power steering pump as is used in automotive vehicles. Power steering pumps normally include bypass valves to provide pressure relief by controlling the amount of diversion of hydraulic fluid from the output of the pump to the input of the pump or to its source at those times when more or less steering assist is required. In most cases, the bypass valve control is controlled by mechanical means in reaction to either the speed at which the pump is driven or by the internal pressures of the pump sensed by the valve. In some cases, electrical control has been employed to control a bypass valve.

The claimed invention is directed to a power steering pump which includes an electrically controlled bypass valve of a unique configuration that functions to provide improvements in the overall operation and efficiencies, as compared to prior art pumps.

Independent claim 7 (detailed in the following chart) is directed to a power steering pump [10] that includes a housing [12] which defines a bore [34] having an axis [36], an outlet [27] adjacent one end of the bore [34], a fluid discharge port [20] communicating with the bore [34] at a first axial location and a fluid bypass port [30] communicating with the bore [34] at a second axial location. The pump [10] also includes pumping elements (rotors [14], vanes [26] and cam chamber [18]) disposed within the housing [10] for pumping fluid to the fluid discharge port [20] and communicating with the bypass port [30] for drawing fluid therefrom. A flow control valve [38] is slideably received in the bore [34] and defines an inlet to the bypass port [30]. A plunger [78/38] (part of valve 38) is operatively connected to the flow control valve [38] and is responsive to an applied electromagnetic field to slide the flow control valve [38] to various positions between a fully closed position wherein the flow control valve [38] closes the inlet to the bypass port [30] and a fully open position wherein maximum fluid flows from the bore [34] to the fluid bypass port [30] through the inlet [48]. A spring [70] is operatively coupled to the flow control valve [38] for biasing the flow control valve [38] in the open position and an electromagnetic coil [62] is included for applying an electromagnetic field to the plunger [78/38] to vary the position of the plunger [78/38] and thereby vary the size of the inlet and to proportionally control fluid flow to the fluid bypass port [30].

Subject Matter of Independent Claim 7 With Respect to Patent Application No. 10/631,129

7. A power steering pump [10] comprising: a housing [12] defining a bore [34] having an axis [36],	• Figs. 1&2 & Page 4, Par. [0012] lines 1-3: "In accordance with a preferred embodiment of this invention, referring to Figs. 1 and 2, there is depicted a power steering pump 10 for supplying pressurized fluid for a power steering system..." • Figs. 1&2 & Page 4, Par. [0012] lines 3- 4: "Pump 10 comprises a housing 12..." • Figs. 1&2 & Page 4, Par. [0013] lines 3-4: "...a bore 34 is provided in housing 12 and has a central axis 36.'"
an outlet [27] adjacent one end of the bore [34],	• Fig. 1 & Page 4, Par. [0013] lines 5-6: "...bore 34 extends partially through the housing and includes an open end adjacent outlet 27."
a fluid discharge port [20] communicating with the bore [34] at a first axial location, and a fluid bypass port [30] communicating with the bore [34] at a second axial location;	• Figs. 1&2 & Page 4, Par. [0013] lines 6-8: "Bore 34 also communicates with discharge port 20 at a first axial location and with bypass port 30 at a second axial location that is axially spaced from the first location."
pumping elements disposed within the housing [12] for pumping fluid to said fluid discharge port [20] and communicating with said bypass port [30] for drawing fluid therefrom;	• Fig. 1 & Page 4, Par. [0012] lines 6-9: "Housing 12 contains pumping element, showing schematically, that include a rotor 14 that propels retractable vane 16 within a cam chamber 18."; Par [0012] lines 10-14: "Fluid is pumped under pressure to discharge port 20 and exits through an outlet 27 in adapter 26, as output 28. Adapter 26 is connected through tubing to a rotary valve and steering gear of the power steering system. Fluid is returned to the pump through a return line (not shown) connected to suction passage 24 and is, in turn, drawn into cam chamber 18." Par [0013] lines 1-3: "In accordance with this invention, the volume of output 28 from the pump is controlled by recycling a portion of the pumped fluid through a bypass port 30 to suction passage 24, as indicated by arrow 32."
a flow control valve [38] slideably received in the bore [34] and defining an inlet to the bypass port [30];	• Figs. 1&2 & Page 5, Par. [0014] lines 1-5: "Fluid to bypass port 30 is controlled by a flow control valve assembly that includes a flow control valve 38 slideably received in sleeve 40 inserted in bore 34. Sleeve 40 comprises openings 42 and a circumferential groove 44

	in fluid communication with fluid discharge port 20 and also comprises openings 46 and circumferential groove 48 in fluid communication with fluid bypass port 30."
a plunger [78/38] operatively connected to the flow control valve [38] and responsive to an applied electromagnetic field to slide the flow control valve [38] to various positions between a fully closed position wherein the flow control valve [38] closes the inlet and a fully open position wherein maximum fluid flows from the bore [34] to the fluid bypass port [30] through the inlet [48];	• Fig. 1 & Page 3, Par. [0017] lines 1- 9: "Valve 38 is preferably formed of steel or other suitable magnetizeable material and thus serves as the plunger for the solenoid assembly. Thus, valve 38 moves axially in response to the applied electrical field to the closed position shown in Fig. 2."; Par. [008] lines 1-3: "...the pump includes a solenoid assembly that comprises a plunger that is connected to the flow control valve and is responsive to an applied electromagnetic field to actuate the plunger."
a spring [70] operatively coupled to the flow control valve [38] for biasing the flow control valve [38] in the open position;	• Fig. 1 & Page 6, Par. [0016], lines 1-2: "...valve 38 is biased in the fully open position shown in Fig. 1 by coil spring 70."
an electromagnetic coil [62] for applying an electromagnetic field to the plunger [78/38] to vary the position of the plunger [78/38] and thereby vary the size of the inlet and to proportionally control fluid flow to the fluid bypass port [30].	• Figs. 1&2 & Par. [0008] lines 3-9: "An electromagnetic coil is provided outside the bore for applying an electromagnetic field to actuate the plunger. The position of the flow control valve depends upon the magnitude of the applied electromagnetic field, which in turn is regulated by the flow of current to the electromagnetic coil. By controlling electrical current to the electromagnetic coil, the size of the inlet to the bypass port is adjusted to control the proportion of fluid recycled through the bypass port."

Independent Claim 10 (detailed in the following chart) is directed to a power steering pump [10] that includes a housing [12] defining a bore [34] having an axis [36] and open end as well as a fluid discharge port [20] communicating with the bore [34] at a first axial location proximate to the open end, and a fluid bypass port [30] communicating with the bore [34] at a second axial location. The pump [10] also includes pumping elements (rotors [14], vanes [26] and cam chamber [18]) disposed within the housing [12] and adapted for drawing fluid from the fluid bypass port [30] and pumping fluid to the fluid discharge port [20]. In this case, a sleeve [40] is received in the bore [34] which has an opening [46] communicating with the fluid bypass port [30]. A flow control valve [38] is slideably received in the bore [34] and has an opening [56]. The flow control valve [38] is slideable to various positions between a fully closed position that closes the opening [46] in the sleeve [40] and a fully open position. The opening [56] in the flow control valve [38] cooperates with the opening [46] in the sleeve [40] to define an inlet to proportionally control fluid flow to the fluid bypass port [30]. In addition, a tubular extension [64] is sealingly mounted onto the housing [10] at the open end and a plunger [78] is disposed within the tubular extension and operatively connected to the flow control valve. The plunger [78] is responsive to an applied electromagnetic field to slide the valve [38] axially to various open positions between the fully closed position and the fully open position and to vary the position of the flow control valve [38] and thereby vary the size of the inlet to the fluid bypass port [30]. A spring [70] engages the plunger [78] and is included for biasing the flow control valve in the open position. An electromagnetic coil [62] is disposed about the extension. The coil is adapted for applying an electromagnetic field to the plunger [78] and causing it to be responsively positioned.

Subject Matter of Independent Claim 10 With Respect to Patent Application No. 10/631,129

10. A power steering pump [10] comprising:	• Figs. 1&2 & Page 4, Par. [0012] lines 1-3: "In accordance with a preferred embodiment of this invention, referring to Figs. 1 and 2, there is depicted a power steering pump 10 for supplying pressurized fluid for a power steering system..." •
a housing [12] defining a bore [34] having an axis [36] and open end, a fluid discharge port [20] communicating with the bore [34] at a first axial location proximate to the open end, and a fluid bypass port [30] communicating with the bore [34] at a second axial location;	• Figs. 1&2 & Page 4, Par. [0012] lines 3- 4: "Pump 10 comprises a housing 12..." • Figs. 1&2 & Page 4, Par. [0013] lines 3-4: "...a bore 34 is provided in housing 12 and has a central axis 36.'" • Fig. 1 & Page 4, Par. [0013] lines 5-6: "...bore 34 extends partially through the housing and includes an open end adjacent outlet 27." • Figs. 1&2 & Page 4, Par. [0013] lines 6-8: "Bore 34 also communicates with discharge port 20 at a first axial location and with bypass port 30 at a second axial location that is axially spaced from the first location."
pumping elements disposed within the housing [12] and adapted for drawing fluid from the fluid bypass port [30] and pumping fluid to said fluid discharge port [20];	• Fig. 1 & Page 4, Par. [0012] lines 6-9: "Housing 12 contains pumping element, showing schematically, that include a rotor 14 that propels retractable vane 16 within a cam chamber 18."; • Par. [0012] lines 10-14: "Fluid is pumped under pressure to discharge port 20 and exists through an outlet 27 in adapter 26, as output 28. Adapter 26 is connected through tubing to a rotary valve and steering gear of the power steering system. Fluid is returned to the pump through a return line (not shown) connected to suction passage 24 and is, in turn, drawn into cam chamber 18." • Par [0013] lines 1-3: "In accordance with this invention, the volume of output 28 from the pump is controlled by recycling a portion of the pumped fluid through a bypass port 30 to suction passage 24, as indicated by arrow 32."

a sleeve [40] received in bore [34] and having an opening [46] communicating with the fluid bypass port [30];	• Figs. 1&2 & Page 5, Par. [0014] lines 1-5; "Fluid to bypass port 30 is controlled by a flow control valve assembly that includes a flow control valve 38 slideably received in sleeve 40 inserted in bore 34. Sleeve 40 comprises openings 42 and a circumferential groove 44 in fluid communication with fluid discharge port 20 and also comprises openings 46 and circumferential groove 48 in fluid communication with fluid bypass port 30.
a flow control valve [38] slideably received in the bore [34] having an opening [56], said flow control valve[38] being slideable to various positions between a fully closed position that closes the opening [46] in the sleeve [40] and a fully open position, wherein the opening [56] in the flow control valve [38] cooperates with the opening in the sleeve [46] to define an inlet to proportionally control fluid flow to the fluid bypass port [30];	• Figs. 1&2 & Pages 5-6, Par. [0014] lines 17-26: "Moreover, during operation, when valve 38 is open, for example, in the fully open position depicted in Fig. 1, fluid flows from central passage 50 through openings 46 and groove 58 of valve 38, and thereafter through openings 56 and groove 48 to bypass port 30. This permits an excess portion of the pumped fluid to be recycled through bypass port 30 to control the output from the pump. In the closed position shown in Fig. 2, valve 38 slides to axially displace openings 56 relative to openings 46 in sleeve 40, where the circumferential surface of valve 38 closes the openings 46 in sleeve 40 to prevent fluid flow to bypass port 30. Thus, in this embodiment, openings 46 and 56 cooperate to define the inlet to fluid bypass port 30."
a tubular extension [64] sealing mounted onto the housing [10] at said open end;	• Fig. 1 & Page 6, Par. [0015] lines 3-5: "Coil 62 is disposed about a conduit extension 64 that is connected at one end to sleeve 40 and at the opposite end to adaptor 26, using O-ring 66 and 68 to seal the connections."

a plunger [76/38] disposed within the tubular extension [64] and operatively connected to the flow control valve [38], said plunger [76/38] being responsive to an applied electromagnetic field to slide the valve [38] axially to various open positions between the fully closed position and the fully open position and to vary the position of the flow control valve [38] to thereby vary the size of the inlet;	• Fig. 1 & Page 3, Par. [0017] lines 1- 9: "Valve 38 is preferably formed of steel or other suitable magnetizeable material and thus serves as the plunger for the solenoid assembly. Thus, valve 38 moves axially in response to the applied electrical field to the closed position shown in Fig. 2."; • Par. [0008] lines 1-3: "...the pump includes a solenoid assembly that comprises a plunger that is connected to the flow control valve and is responsive to an applied electromagnetic field to actuate the plunger." • Figs. 1&2 & Par. [0008] lines 7-9: "...the size of the inlet to the bypass port is adjusted to control the proportion of fluid recycled through the bypass port."
a spring engaging the plunger for biasing the flow control valve in the open position;	• Fig. 1 & Page 6, Par. [0016], lines 1-2: "...valve 38 is biased in the fully open position shown in Fig. 1 by coil spring 70."
an electromagnetic coil disposed about the extension and adapted for applying an electromagnetic field to the plunger and causing it to be responsively positioned.	• Figs. 1&2 & Par. [0008] lines 3-9: "An electromagnetic coil is provided outside the bore for applying an electromagnetic field to actuate the plunger. The position of the flow control valve depends upon the magnitude of the applied electromagnetic field, which in turn is regulated by the flow of current to the electromagnetic coil. By controlling electrical current to the electromagnetic coil, the size of the inlet to the bypass port is adjusted to control the proportion of fluid recycled through the bypass port."

VI. GROUNDS OF REJECTION (37CFR § 41.37(c)(1)(vi))

First Ground of Rejection:

Rejection of Claims 7-11 under 35 USC 103(a) as being unpatentable over Fujimura, et al 5,860,797 (Evidence Appendix A) in view of Duffy 4,877,099 (Evidence Appendix B).

Second Ground of Rejection:

Rejection of Claims 7-11 under the non-statutory grounds of obviousness-type double patenting over claims 2, 4, 5, 7 8 and 10-14 of co-pending Application No. 10/631363.

VII. ARGUMENT (37CFR § 41.37(c)(1)(vii))

First Ground of Rejection:

Claims 7-11

Appellants' Request for Reconsideration After Final Rejection (page 3, lines 13 + et seq.) explains how the Examiner failed to establish a prima facie case of obviousness and failed to provide sufficient and valid evidence to support a rejection of claims based on 35 USC 103(a).

- There was a failure to analyze the knowledge necessary by one skilled in art at the time of the invention was made which would have motivated such a person to make the proposed modification or the claimed invention.
- There was a failure to describe how the cited references suggested the motivation to the combination or modification proposed by the Examiner.
- There was a failure to acknowledge that the combined references did not provide a coherent and conclusive teaching of the claimed invention.

Even after receiving the detailed explanation in the aforementioned Request for Reconsideration, the Examiner refused to withdraw the rejection and caused this appeal.

In this case, the main reference relied on, Fujimura et al, fails to describe or show the claimed invention and fails to suggest the combination of elements the Examiner has attempted to assemble by combining it with Duffy. By alleging

that electrically controlled valves are well known, The Examiner has combined Fujimura, et al (mechanically controlled) with Duffy (electrically controlled). However, even that combination is insufficient if view of the claim language.

Neither Fujimura, et al nor Duffy suggest a steering pump with the elements of the combination as set forth in claims 7-11. Additionally, there is no suggestion in either patent or in any other publication cited to date which would lead one skilled in the art to make the combination alleged by the Examiner. The Examiner has not expressed any particular knowledge by one skilled in this art that would cause such individual to make the alleged combination.

Rather than suggest that the device should be modified to be electrically controlled, Fujimura et al teaches away from such a concept. Fujimura et al discloses a flow rate control device for a power steering pump that includes a hydraulic pressure reactive spool valve 16. The spool valve is elongated, but not uniform in diameter, and is axially slidable within an inner hole 15 in a housing 1. The spool valve responds to feedback pressure from the discharge port to slide within the hole and regulate the amount of operating fluid that flows back to a pump reservoir (col. 5, lines 1-3). The concept employed uses the principle of preventing by-pass flow when the system is at rest and only opening up the by-pass flow path in response to pump fluid pressure. There is no mention or suggestion in Fujimura et al that one should add any electrical control to the valve shown in its many embodiments or how such modification should be applied.

The Examiner took note of some of the deficiencies in Fujimura et al by stating: "Fujimura et al does not disclose an electrical means for sliding the flow control valve." However, Fujimura et al also fails to disclose other claimed elements. For instance, a plunger element that is operatively connected to the flow valve and responsive to an applied electric field to slide the flow control valve to various positions between fully closed and fully open positions. Further, Fujimura et al fails to disclose a spring that is operatively coupled to the flow control valve for biasing the flow control valve in the open position. Rather, Fujimura et al teaches the use of springs to bias the valve in a closed position to close fluid flow to the by-pass port.

As mentioned above, Fujimura et al teaches that the valved pathway from the input port 1b to the bypass port 1a is closed by the position of the spool valve 16 when in its

normally biased position. The spring 15 functions to bias the valve to keep this pathway normally closed. It is only after sufficient pressure is achieved in the discharge pressure chamber 25 and is in balance with the pressure in the pressure reducing chamber 23 that the spool element 16 is moved to the left (Fig. 3 and col. 4, lines 55-67) and causes the communication between input port to the bypass port. This is completely opposite to what Appellants are claiming.

Duffy teaches an electronically controlled throttling valve for use in conjunction with a power steering system. In reaction to various sensor outputs in the system, a CPU applies pulse width modulation ("pwm") signals to an electromagnetic coil to axially adjust the valve to its predetermined open and closed positions. The effect of pwm signals is to vary the times between open and closed to correspondingly adjust the degree of restriction between the input and output passages of the valve. The throttle valve of Duffy does not perform the same functions of the claimed invention because it is merely a solenoid driven valve that has two states or positions: open and closed. There is no suggestion of a valve that is controlled to various positions between its fully open and fully closed positions.

The Examiner has made the leap to conclude that the combined teachings of Fujimura et al and Duffy render the claims obvious, without defining the attributes of one skilled in the art; without knowing what one skilled in the art would have done in the face of those references; and without finding one hint or suggestion in either Fujimura et al or Duffy that the elements of the Appellants' claims are directed to an obvious combination. The Examiner's analysis of the references failed to take into account the four criteria stated in MPEP §706.02(j) Contents of a 35 U.S.C. 103 Rejection:

> *"...the Examiner should set forth in the Office action:*
> *(A) the relevant teachings of the prior art relied upon, preferably with reference to the relevant column or page number(s) and line number(s) where appropriate,*
> ***(B) the difference or differences in the claim over the applied reference(s),***
> ***(C) the proposed modification of the applied reference(s) necessary to arrive at the claimed subject matter, and***
> ***(D) an explanation why one of ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification."***

(emphasis added)

(Complete copy provided in (Evidence Appendix C)

In particular, the Examiner did not comply with parts B, C and D of the above-quoted MPEP Section.

The Examiner has made a conclusion that *"...it would have been obvious to one of ordinary skill in the art to modify Fujimura et al by replacing the hydraulic actuation with an electrical means as taught by Duffy to regulate flow to the fluid bypass port as a means of electronically controlling the valve is [sp] response to vehicle specific values. such as speed."* Contrary to the Examiner's conclusion, and as required by the MPEP and case law, the basis for combining references to support a rejection on obviousness must come from the references themselves or that knowledge generally available to one of ordinary skill in the art to modify the reference or to combine the relevant teachings. The mere fact that the two references are in the same field does not provide the necessary knowledge, suggestion or obvious push to make the combination. Moreover, the knowledge that one skilled in the art must have to make the combination has not been alleged or in any way presented.

Another basic failure in the alleged combination made by the Examiner is the "obvious" result of such combination. It is not conclusive that if one were to combine the references cited by the Examiner, that Appellants' invention would be the result. For instance, if one skilled in the art were to add an electrical coil to Fujimura et al device, where would it be added? What alterations would be needed to make the valve perform as Appellants have claimed? How would the chambers have to be modified since the device is no longer pressure controlled. These are but a few of the questions that were not addressed in the alleged combination. Appellants submit that the broad concept of adding electrical control to a by-pass valve is not what is claimed in the application. Rather, a precise combination of interactive elements is recited in the claims and neither of the references, individually or in combination can show those claims to be a mere obvious rendering of the references.

The recent case KSR International Co. v. Teleflex, Inc. 550 U.S. ____ (2007) No. 04-1350, at 2 (Evidence Appendix D) reinforces the principle in Graham v. John Deere 383 U.S. 1 (1966) (Evidence Appendix E):

> "Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." *Id.*, at 17.18.

The rejection being discussed in this brief also fails under that test. Short of Appellants' recitation in the claims, there is no other basis on which one can allege the combination at the time of Appellants' invention. No level of ordinary skill test. No determination against that background. No secondary considerations were made, such as the teaching away by the Fujimura et al patent. In addition, the references as combined by the Examiner are insufficient to evidence a rejection under 35 USC (103)(a).

Accordingly, the Examiner's decision should be reversed and the Board should hold that the claims are allowable over the cited references.

Second Ground of Rejection:

Claims 7-11

According to the MPEP 804.02
Avoiding a Double Patenting Rejection – II NonStatutory:

> "A rejection based on a nonstatutory type of double patenting can be avoided by filing a terminal disclaimer in the application or proceeding in which the rejection is made. " (Complete copy in Evidence Appendix F)

Appellants' Request for Reconsideration After Final Rejection was accompanied by a terminal disclaimer (Copy in Evidence Appendix G). Therefore, this rejection under the non-statutory grounds of obviousness-type double patenting over claims 2, 4, 5, 7 8 and 10-14 of co-pending Application No. 10/631363 should have been withdrawn.

Conclusion

For each of the reasons discussed above, including the failure of the cited references to support the rejections under 35 USC §103(a), Appellants request this Honorable Board to reverse the rejection of the claims by the Examiner and to hold allowable all claims under consideration in the application.

Required sections under 37 CFR § 41.37(c)(1)(viii) – (x) are provided in the following Appendices.

This Appeal Brief is being submitted in triplicate. .

Respectfully submitted,

Paul K. Godwin
Registration No. 27725
Attorney for Appellant(s)

Date: September 10, 2007
Tel. 810-844-0032

INDEX TO APPENDICES

CLAIMS APPENDIX (37CFR § 41.37(c)(1)(viii))

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix A	US Patent 5,860,797 - Fujimura, et al
Appendix B	US Patent 4,877,099 – Duffy
Appendix C	MPEP §706.02(j) Contents of a 35 U.S.C. 103 Rejection
Appendix D	KSR International Co. v. Teleflex, Inc. 550 U.S. ____ (2007) No. 04-1350, Decided April 30. 2007.
Appendix E	Graham v. John Deere 383 U.S. 1 (1966)
Appendix F	MPEP 804.02 Avoiding a Double Patenting Rejection
Appendix G	Terminal Disclaimer

RELATED PROCEEDINGS APPENDIX (37CFR § 41.37(c)(1)(x))

None

CLAIMS APPENDIX (37CFR § 41.37(c)(1)(viii))

7. A power steering pump comprising:

a housing defining a bore having an axis, an outlet adjacent one end of the bore, a fluid discharge port communicating with the bore at a first axial location, and a fluid bypass port communicating with the bore at a second axial location;

pumping elements disposed within the housing for pumping fluid to said fluid discharge port and communicating with said bypass port for drawing fluid therefrom;

a flow control valve slideably received in the bore and defining an inlet to the bypass port;

a plunger operatively connected to the flow control valve and responsive to an applied electromagnetic field to slide the flow control valve to various positions between a fully closed position wherein the flow control valve closes the inlet and a fully open position wherein maximum fluid flows from the bore to the fluid bypass port through the inlet;

a spring operatively coupled to the flow control valve for biasing the flow control valve in the open position;

an electromagnetic coil for applying an electromagnetic field to the plunger to vary the position of the plunger and thereby vary the size of the inlet and to proportionally control fluid flow to the fluid bypass port.

8. A power steering pump in accordance with claim 7 wherein the pumping elements comprise a cam chamber and a rotor having retractable vanes disposed within the cam chamber.

9. A power steering pump in accordance with claim 7, further comprising a sleeve received in the bore and having an opening communicating with the fluid bypass port, and wherein the flow control valve is slideably received within the sleeve and includes an opening that cooperates with the opening in the sleeve to define the inlet to the fluid bypass port.

10. A power steering pump comprising:

a housing defining a bore having an axis and open end, a fluid discharge port communicating with the bore at a first axial location proximate to the open end, and a fluid bypass port communicating with the bore at a second axial location;

pumping elements disposed within the housing and adapted for drawing fluid from the fluid bypass port and pumping fluid to said fluid discharge port;

a sleeve received in bore and having an opening communicating with the fluid bypass port;

a flow control valve slideably received in the bore having an opening, said flow control valve being slideable to various positions between a fully closed position that closes the opening in the sleeve and a fully open position, wherein the opening in the flow control valve cooperates with the opening in the sleeve to define an inlet to proportionally control fluid flow to the fluid bypass port;

a tubular extension sealing mounted onto the housing at said open end;

a plunger disposed within the tubular extension and operatively connected to the flow control valve, said plunger being responsive to an applied electromagnetic field to slide the valve axially to various open positions between the fully closed position and the fully open position and to vary the position of the flow control valve to thereby vary the size of the inlet;

a spring engaging the plunger for biasing the flow control valve in the open position;

an electromagnetic coil disposed about the extension and adapted for applying an electromagnetic field to the plunger and causing it to be responsively positioned.

11. A power steering pump in accordance with claim 10 wherein the extension includes an end cap, and wherein plunger includes a rear end adjacent the end cap and a pressure equalization passage extending from the rear end and communicating with fluid adjacent the flow control valve.

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix A

US Patent 5,860,797 - Fujimura, et al

US005860797A

United States Patent [19]

Fujimura et al.

[11] Patent Number: 5,860,797

[45] Date of Patent: Jan. 19, 1999

[54] **FLOW RATE CONTROL DEVICE FOR A PUMP**

[75] Inventors: **Haruo Fujimura; Shunichi Higuchi; Kazuhiro Maki**, all of Aichi, Japan

[73] Assignee: **Aisin Seiki Kabushiki Kaisha**, Kariya, Japan

[21] Appl. No.: **627,125**

[22] Filed: **Apr. 3, 1996**

[30] **Foreign Application Priority Data**

Apr. 4, 1995 [JP] Japan 7-078658
Apr. 20, 1995 [JP] Japan 7-095029

[51] **Int. Cl.**[6] **F04B 49/24**

[52] **U.S. Cl.** **417/440**; 417/300; 417/307; 137/115.06

[58] **Field of Search** 417/440, 441, 417/300, 310, 274, 285, 288, 299, 301, 303, 307; 137/115.01, 492.5, 115.03, 115.05, 115.06, 115.1, 115.08, 115.16–15.2; 251/333, 343, 344

[56] **References Cited**

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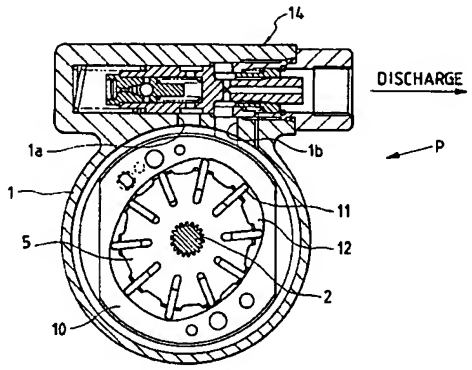
Primary Examiner—Ismael Izaguirre
Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis, LLP

[57] **ABSTRACT**

A flow rate control device for a pump includes a housing, a choke tubular passageway connected between a pump pressure chamber and an output chamber, a spool valve which is slidably provided in the housing, and which has both ends exposed in the pump pressure chamber and the pressure reducing chamber, respectively, the spool valve causing a pressure medium to flow from the pump pressure chamber into the by-pass port as much as the spool valve slides in an axial direction thereof. In the device, the choke tubular passageway is formed in a central shaft member arranged in the housing, and a sleeve member is provided around the central shaft member, the sleeve member being moved, from the pump pressure chamber towards the pressure reducing chamber, with respect to the central shaft member, in such a manner as to change the opening area of the choke tubular passageway.

10 Claims, 4 Drawing Sheets



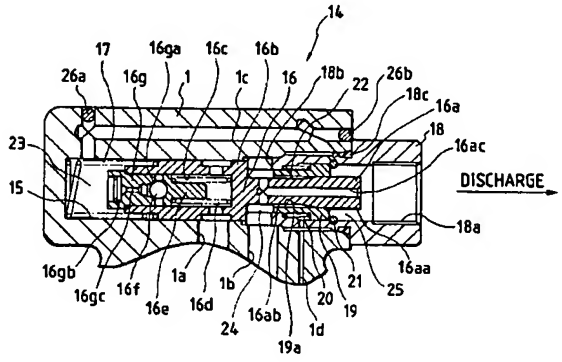


FIG. 1

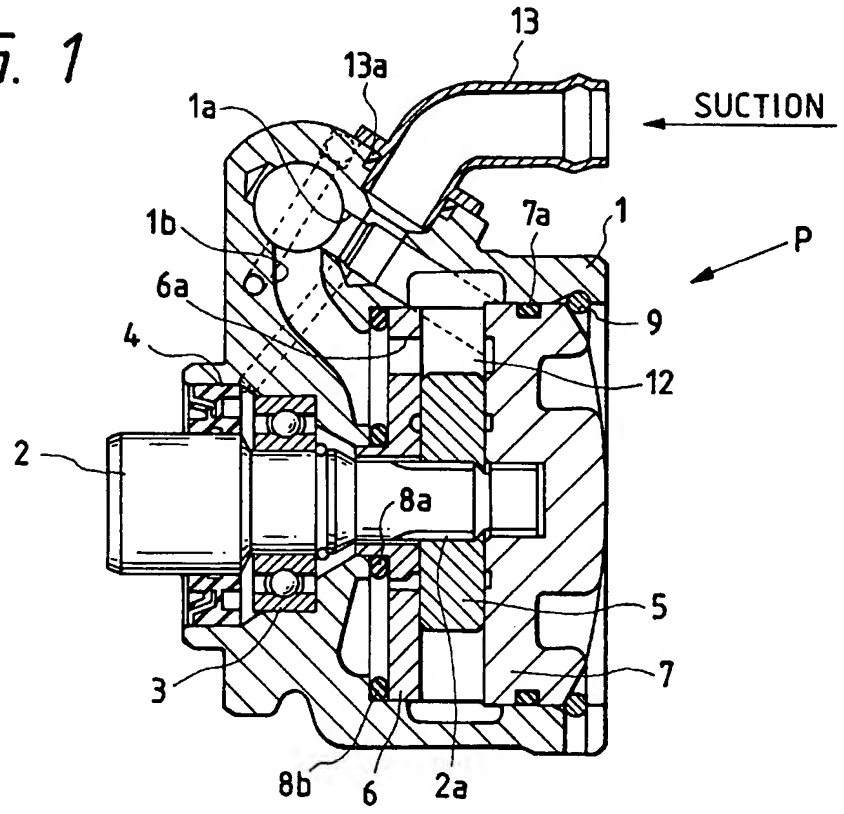


FIG. 2

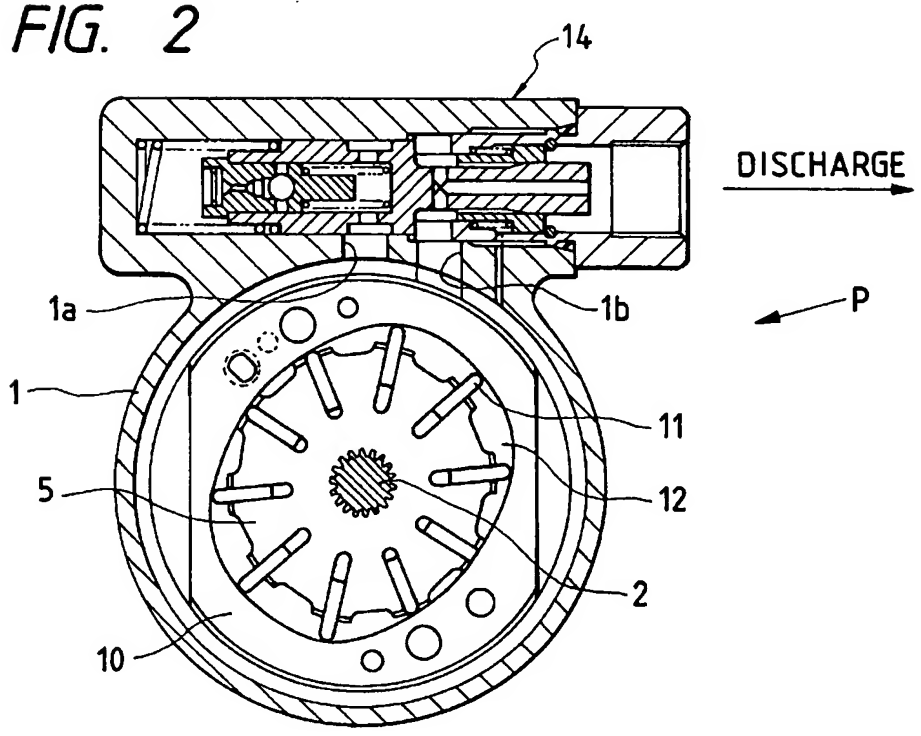


FIG. 3

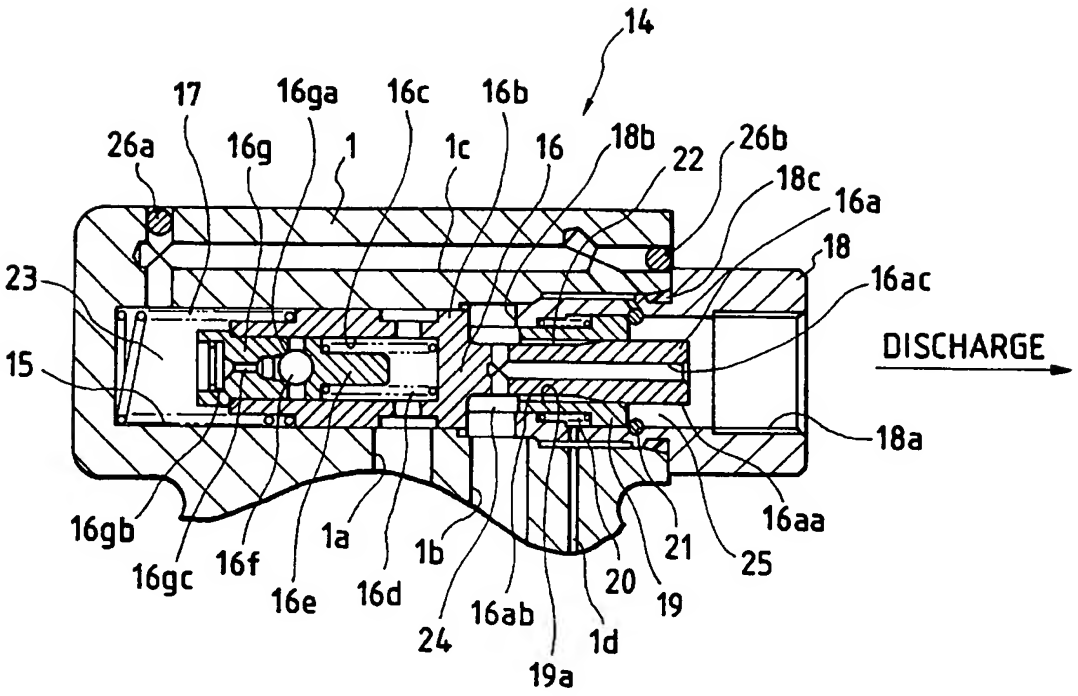


FIG. 4

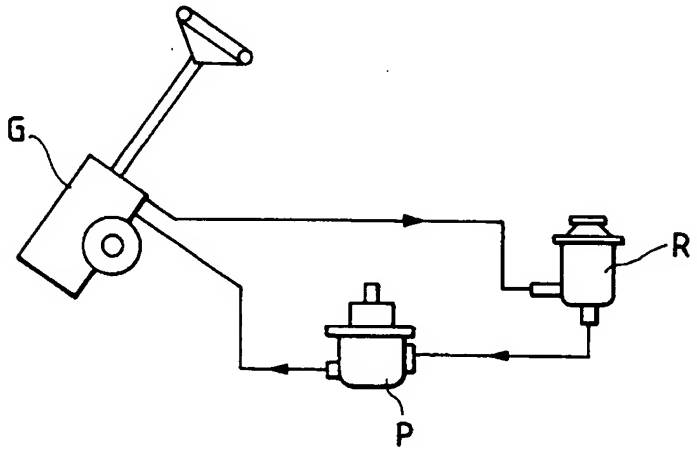


FIG. 5

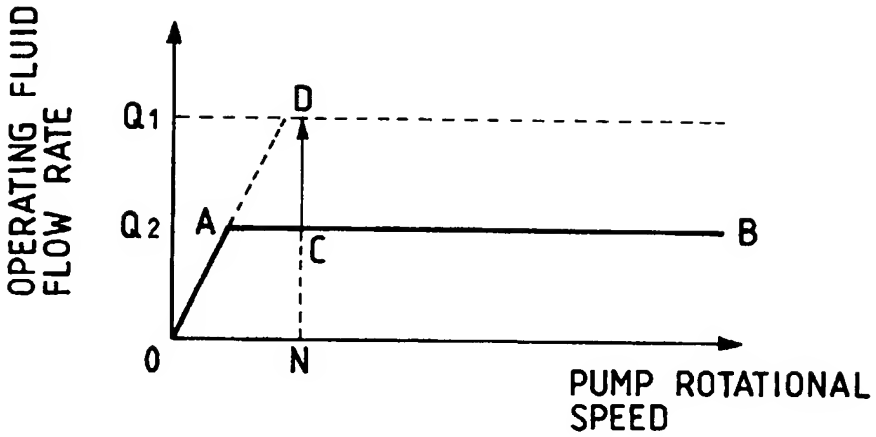


FIG. 6

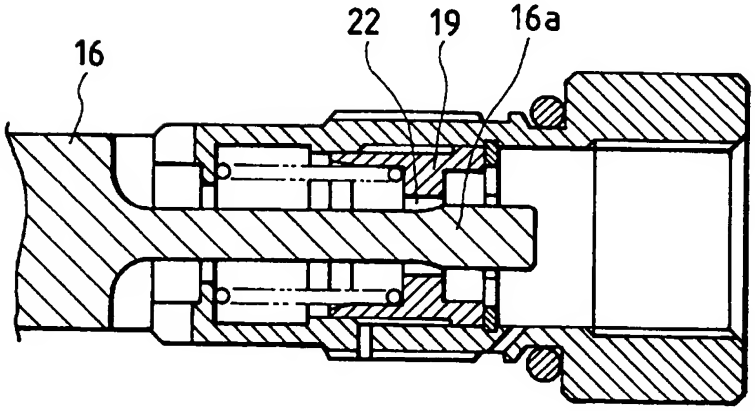


FIG. 7

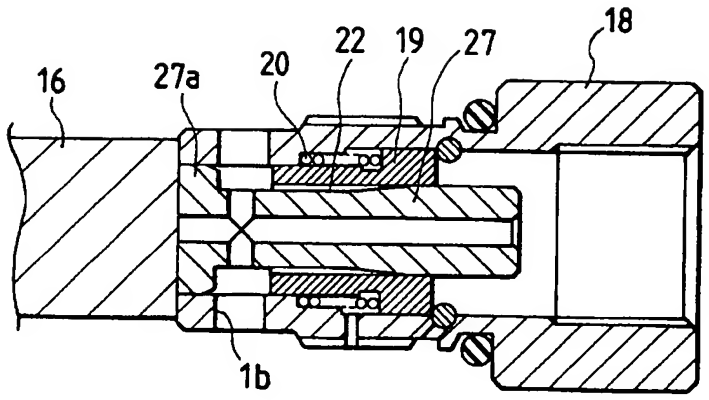


FIG. 8

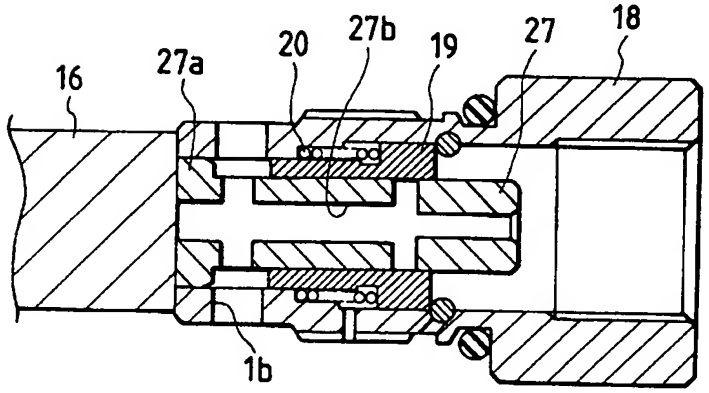
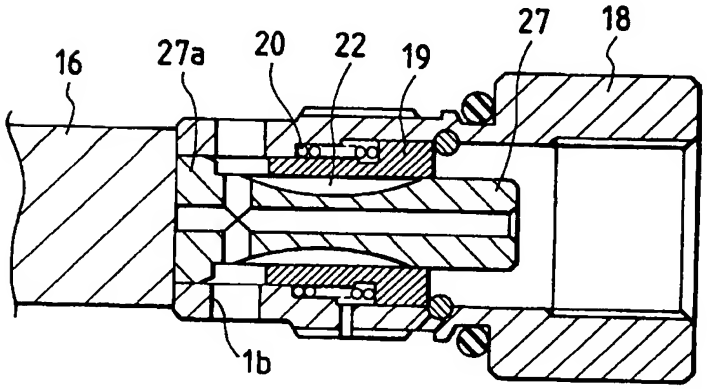


FIG. 9



FLOW RATE CONTROL DEVICE FOR A PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a flow rate control device for a hydraulic pump which is applied mainly to a steering device of an automobile.

2. Description of the Related Art

A flow rate control device for a hydraulic pump has been disclosed, for instance, in Japanese Patent Application Examined Publication No. Hei 6-71889. The conventional flow rate control device disclosed therein comprises: a flow rate control valve that by-passes a pressure medium according to a pump discharge flow rate which changes with the speed of rotation of a pump, so that the discharge flow rate is made constant independently of the speed of rotation of the pump; and a change-over valve which operates according to a load pressure produced according to the operating condition of the steering device. That is, it is a flow rate control device of the load-sensitive type which, when the load of the steering device increases, causes the pump to increase the flow rate of operating fluid applied to the steering device.

However, as was described above, the conventional flow rate control device needs the flow rate control valve and the change-over valve which are two completely independent valves. Therefore, the flow rate control device is unavoidably bulky, thereby making it rather difficult to install it in the recently overcrowded engine room in which a large number of components have been installed. That is, it has problems to be solved for its installation in the engine room and for reduction of the weight thereof.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of the invention is to provide a load-sensitive flow rate control device for a pump which is small in size and light in weight.

The foregoing object of the invention has been achieved by the provision of a flow rate control device for a pump which comprises:

a housing;

a pump pressure chamber provided in the housing into which a pump discharge pressure is led;

a choke tubular passageway communicating with the pump pressure chamber;

an output chamber which communicates through the choke tubular passageway with the pump pressure chamber, and to which a pressure obtained by reducing a pump discharge pressure is led;

a pressure reducing chamber which is provided in the housing and communicates with the output chamber;

a by-pass port which is provided in the housing and communicates with a pump suction side; and

a spool valve which is slidably provided in the housing, which has both ends exposed in the pump pressure chamber and the pressure reducing chamber, respectively, the spool valve causing a pressure medium from the pump pressure chamber to flow into the by-pass port as much as the spool valve slides in an axial direction thereof;

wherein the choke tubular passageway is formed in a central shaft member arranged in the housing, and a sleeve member is provided around the central shaft member, the sleeve member being moved, from the pump pressure chamber towards the pressure reducing chamber, with respect to the central shaft member, in such a manner as to change the opening area of the choke tubular passageway.

With the flow rate control device of the invention, the spool valve is slid on the difference between the pressures applied to both ends of the spool valve, so that the opening degree of the by-pass port is adjusted, and the pressure medium is by-passed. Thus, the pump discharge flow rate can be made constant independently of the speed of rotation of the pump.

Furthermore, the load pressure increased depending on the operating condition of the steering device is applied to the sleeve member, so that the latter moves with respect to the central shaft member to increase the opening area of the choke tubular passageway. Thus, because the opening area of the choke tubular passageway is increased, the discharge flow rate can be increased in accordance with the load pressure produced by the steering device.

The above and other objects and features of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view taken in the direction of axis of a vane pump equipped with a flow rate control device for a pump according to the invention;

FIG. **2** is a cross-sectional front view showing the vane pump having the flow rate control device of the invention;

FIG. **3** is an enlarged sectional view showing a flow rate control device according to a first embodiment of the invention;

FIG. **4** is an explanatory diagram showing a steering system;

FIG. **5** is a characteristic diagram for a description of the discharge flow rate of the flow rate control device of the invention;

FIG. **6** is an enlarged sectional view showing a flow rate control device according to a second embodiment of the invention;

FIG. **7** is an enlarged sectional view showing a flow rate control device according to a third embodiment of the invention;

FIG. **8** is an enlarged sectional view showing a first modification of the flow rate control device shown in FIG. **7**; and

FIG. **9** is an enlarged sectional view showing a second modification of the flow rate control device shown in FIG. **7**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, parts of a flow rate control device for a hydraulic pump, which form specific features of the invention, will be described with reference to the accompanying drawings.

FIG. **4** is a diagram showing a general steering system using a vane pump. In FIG. **4**, reference numeral G designates a steering device for converting the steering operation of a vehicle operator, which is applied to a steering wheel (handle), into the displacement of the steered wheel; R, a reservoir that stores a pressure medium which is an operating fluid; and P is a vane pump with the flow rate control device according to the invention. The vane pump P sucks the operating fluid from the reservoir R, and after adjusting its flow rate to a predetermined value, discharges it to the steering device G, thereby to assist the steering operation of the operator.

FIG. 1 is a cross-sectional view showing the vane pump P taken along the axis of rotation. The vane pump P as shown in FIG. 1, has a housing 1, into which a rotary shaft 2 is inserted. The torque of an engine of a vehicle is transmitted through a pulley (not shown) to the rotary shaft 2. More specifically, the rotary shaft 2 is supported through a bearing 3 on the housing 1. In addition, a seal member 4 is provided between the housing 1 and the rotary shaft 2, thus preventing the entrance of water, dust, etc. into the pump.

A rotor 5 is mounted through a spline 2*a* on the rotary shaft 2 in such a manner that it turns together with the rotary shaft 2. A pressure plate 6 and a thrust plate 7 are provided on both sides of the rotor 5. The pressure plate 6 has a discharge hole 6*a*, and is sealingly held by O-rings 8*a* and 8*b* in the housing 1, which are arranged along the inner periphery and the outer periphery of the pressure plate 6, respectively. On the other hand, the thrust plate 7 is sealingly held by an O-ring 7*a* in the housing 1, which is arranged along the outer periphery of the thrust plate 7. Furthermore, the thrust plate 7 is locked with a snap ring 9 at the right end in FIG. 1. Hence, the aforementioned rotor 5 is held between the pressure plate 6 and the thrust plate 7.

A cam ring 10, as shown in FIG. 2, is provided along the outer periphery of the rotor 5. The rotor 5 has a plurality of vanes 11 which are movable radially of the rotor 5 so that they abut against the cam ring 10. Between the rotor 5 and the cam ring 10, a pump chamber 12 is formed which is divided by the vanes 11 into a plurality of parts.

The housing 1 has an inlet 13 which is used to receive the operating fluid from the reservoir R. More specifically, it is fluidly tightly fitted in the housing 1 through an O-ring 13*a* and communicates with a by-pass port 1*a* formed in the housing 1. The by-pass port 1*a* communicates with the pump chamber 12 and a flow rate control device 14 (described later).

The housing 1 includes an input port 1*b*, which communicates with the discharge hole 6*a* of the pressure plate 6 and with the aforementioned flow rate control device 14.

FIG. 3 is an enlarged diagram showing the aforementioned flow rate control device 14. The housing 1 has an inner hole 15, in which a spool valve 16 is inserted in such a manner that it is axially slidable. The spool valve 16, being engaged with a spring 17, is urged toward the right side in FIG. 3, thus being abutted against a plug 18 (described later). The spool valve 16 includes an elongated portion 16*a* which is elongated to the right in FIG. 3. The elongated portion 16*a* is not uniform in outer diameter; that is, its base end portion, namely, a small-diameter portion 16*ab* is slightly smaller in diameter than its front end portion, namely, a large-diameter portion 16*aa*. In this connection, it should be noted that the large-diameter portion 16*aa* is coupled to the small-diameter portion 16*ab* through a gradually curved annular surface.

The above-mentioned plug 18 serving as one member constituting the housing 1 is threadably engaged with the right end of the aforementioned inner hole 15. The plug 18 has a discharge port 18*a* which is adjusted in pump discharge flow rate by the flow rate control device 14 and through which the operating fluid is discharged towards the above-described steering device G.

A sleeve member 19 is provided between the plug 18 and the spool valve 16 in such a manner that it is slidable in its axial direction. The sleeve member 19 is urged to the right in FIG. 3 by a spring 20 so that it is abutted against a snap ring 21 which is secured to the plug 18. The sleeve member 19 has a flow rate hole 19*a*, which forms a choke tubular passageway 22 in combination with the large-diameter portion 16*aa* and the small-diameter portion 16*ab* of the spool valve 16. The aforementioned elongated portion 16*a* has a pipe passageway 16*ac* having a choke effect. An O-ring 18*c* is employed to fluidly tightly isolate the inner hole 15 from the outside, and a communicating hole 1*d* communicates with the pump suction side.

The spool valve 16 has a valve section 16*b*, and as the spool valve 16 is axially moved, the input port 1*b* communicates with or is isolated from the by-pass port 1*a*.

The spool valve 16 has a valve hole 16*c*. A retainer 16*e* is urged by a spring 16*d*, and a ball 16*f* are sealingly set in the valve hole 16*c*. Under this condition, a valve plug 16*g* is threadably engaged with the valve hole 16*c*. The valve plug 16*g* has a valve seat 16*ga*, a strainer 16*gb* for removing foreign matter, and a fluid passageway 16*gc*. Those members serve as a relief valve to prevent the flow rate control device 14 from being damaged when the pump discharge pressure becomes abnormally high.

A pressure reducing chamber 23 is provided on the left side of the spool valve 16 in FIG. 3, and an input pressure chamber 24 is provided on the right side of the valve section 16*b*, and a discharge pressure chamber 25 is provided on the right side of the spool valve 16. The pressure reducing chamber 23 and the discharge pressure chamber 25 communicate with each other through a communicating passageway 1*c* formed in the housing 1. In FIG. 3, reference characters 26*a* and 26*b* designate ball plugs which sealingly close the communicating passageway 1*c* from the outside.

Now, the operation of the embodiment thus constructed will be described.

When the rotation of the engine is transmitted through a pulley (not shown) to the rotary shaft 2, the rotor 5 is turned together with the latter 2. The pump chamber 12 formed between the rotor 5 and the cam ring 10 repeatedly expands and contracts as the rotor 5 rotates. Hence, the operating fluid sucked in from the reservoir R through the inlet 13 and the bypass port 1*a* is increased in pressure during compression into a pump discharge pressure. The pressure thus formed is led into the input chamber 24 of the flow rate control device 14 through discharge hole 6*a* of the pressure plate 6 and the input port 1*b*.

Part of the operating fluid, which is led in the input pressure chamber 24 and provides the pump discharge pressures, is led into the discharge pressure chamber 25 through the choke tubular passageway 22 between the elongated portion 16*a* of the spool valve 16 and the sleeve member 19, and the pipe passageway 16*ac* with a choke effect, which is provided at the elongated portion 16*a*. Thus, the operating fluid is allowed to flow through the choke tubular passageway 22 at a predetermined flow rate, so that the pump discharge pressure, being reduced to a predetermined value, is transmitted to the discharge pressure chamber 25. The pressure is simultaneously applied through the communication passageway 1*c* to the pressure reducing chamber 23. Hence, the spool valve 16 is moved toward the left in FIG. 3 until the sum of the elastic force of the spring 17 and the pressure which is obtained by reducing the pump discharge pressure in the pressure reducing chamber 23; that is, a force of urging the spool valve 16 to the right in FIG. 3 is balanced with a force of urging the spool valve to the left in FIG. 3 which is provided by the pump discharge pressure led into the input pressure chamber 24. Since the spool valve 16 is moved to the left in FIG. 3 in the above-described manner, the valve section 16*b* of the spool valve 16 allows the by-pass port 1*a* and the input port 1*b* to communicate

with each other, so that a predetermined amount of operating fluid returns from the input pressure chamber **24** through the by-pass port **1***a* into the reservoir R. Hence, the spool valve **16** is moved to the left in FIG. **3** as much as the distance corresponding to the pump discharge flow rate; that is, the degree of opening of the by-pass port **1***a* is adjusted as much as the aforementioned amount of movement, to return the operating fluid into the reservoir R. Therefore, even if the pump discharge flow rate increases, the quantity of operating fluid discharged towards the steering device G is limited to a given value. In FIG. **5**, the relationships between pump rotational speeds and operating fluid flow rates are indicated by a curve O-A-B. In this case, the sleeve member **19** is held at the right end as shown in FIG. **3**. Hence, irrespective of the movement of the spool valve **16**, the choke tubular passageway **22** is defined by the flow rate hole **19***a* of the sleeve member **19** and the large-diameter portion **16***aa* of the spool valve **16**, and therefore its sectional area is small. On the other hand, it should be noted that the pipe passageway **16***ac* is maintained unchanged in sectional area.

When, as in the case where the operator operates the steering device G with the vehicle at a low speed (the pump speed being N), the load pressure is increased on the side of the steering device G, the load pressure is led to the discharge pressure chamber **25** located at the right end of the spool valve **16**, and therefore the sleeve member **19** receives the load pressure, thus being moved to the left in FIG. **3** against the elastic force of the spring **20**. As the sleeve member **19** is moved to the left with respect to the spool valve **16**, the portion of the choke tubular passageway **22** which is defined by the flow rate hole **19***a* of the sleeve member **19** and the small diameter portion **16***ab* of the spool valve **16** (the portion of the choke tubular passageway **22** which is large in sectional area) is increased in length. Therefore, the pressure which is provided by reduction of the pump discharge pressure in the choke tubular passageway **22** is increased, and the pressure in the pressure reducing chamber **23** is also increased. Hence, the spool valve **16** is moved to the right in FIG. **3**, and the quantity of operating fluid discharged into the reservoir R through the by-pass port **1***a* is decreased. Accordingly, because of the introduction of the load pressure, the quantity of operating fluid led into the discharge pressure chamber **25** from the input pressure chamber **24** is increased; that is, the quantity of operating fluid discharged into the steering device G is increased according to the load pressure. In FIG. **5**, the relationships between pump rotational speeds and operating fluid quantities are indicated by a curve C-D.

In the above-described embodiment, the outer diameter of the elongated portion **16***a* of the spool valve **16** is changed in the axial direction; however, the invention is not limited thereto or thereby. That is, the inner diameter of the flow rate hole **19***a* of the sleeve member **19** may be changed in the axial direction. In addition, it goes without saying that the flow rate control device of the invention may be applied to hydraulic pumps other than vane pumps.

FIG. **6** is an enlarged cross-sectional view showing essential components of a flow rate control device in accordance with a second embodiment of the invention. In FIG. **6**, parts corresponding functionally to those already described with reference to the first embodiment are therefore designated by the same reference numerals or characters.

As shown in FIG. **6**, the choke tubular passageway **22** may be formed around a solid elongated portion **16***a* of the spool valve **16**; in other words, the choke tubular passageway **22** may be defined only by the outer cylindrical surface of the elongated portion **16***a* and the inner cylindrical surface of the sleeve member **19**.

FIG. **7** is an enlarged cross-sectional view showing essential components of a flow rate control device in accordance with a third embodiment of the invention.

The third embodiment is different from the above-described first embodiment in the following point: A central shaft member **27** provided in addition to the spool valve **16** has a flange **27***a*. The outer periphery of the flange **27***a* is press-fitted in a plug **18**, so that the central shaft member **27** be a fixed member. Moreover, the sleeve member **19** is so arranged as to be movable with respect to the central shaft member **27**.

FIG. **8** is an enlarged cross-sectional view showing essential components of a first modification of the flow rate control device shown in FIG. **7**. In the modification, as the sleeve member **19** moves axially, the opening of the flow passageway **27***b* formed in the aforementioned central shaft member **27** is changed in area.

FIG. **9** is also an enlarged sectional view showing essential components of a second modification of the flow rate control device shown in FIG. **7**. In the second modification, an arcuate slit is formed in the outer cylindrical surface of the central shaft member **27**, thereby to form a choke tubular passageway **22**.

As is apparent from the above description, the flow rate control device of the invention is the load-pressure sensitive flow rate control device which is small in size and light in weight. Hence, it can be manufactured at low cost, and allows to effectively utilize the engine room in the vehicle.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. The embodiment was chosen and described in order to explain the principles of the invention and its practical application to enable one skilled in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto, and their equivalents.

What is claimed is:

1. A flow rate control device for a pump, comprising:

a housing;

a pump pressure chamber provided in said housing, into which a pump discharge pressure is led;

a choke tubular passageway communicating with said pump pressure chamber;

an output chamber communicating through said choke tubular passageway with said pump pressure chamber, a pressure obtained by reducing the pump discharge pressure being led to said output chamber;

a pressure reducing chamber which is provided in said housing and communicates with said output chamber;

a by-pass port which is provided in said housing and communicates with a pump suction side;

a spool valve which is slidably provided in said housing, which has both ends exposed in said pump pressure chamber and said pressure reducing chamber, respectively, said spool valve causing a pressure medium from said pump pressure chamber to flow into said by-pass port as much as said spool valve slides in an axial direction thereof;

a central shaft member arranged in said housing, on which said choke tubular passageway is formed; and

a sleeve member provided around said central shaft member;

wherein said sleeve member is moved from said pump pressure chamber towards said pressure reducing chamber with respect to said central shaft member in such a manner as to change an opening area of said choke tubular passageway.

2. A flow rate control device for a pump as claimed in claim 1, wherein said central shaft member is changed in outer diameter in an axial direction thereof to define said choke tubular passageway.

3. A flow rate control device for a pump as claimed in claim 1, wherein said sleeve member is changed in inner diameter in an axial direction thereof to define said choke tubular passageway.

4. A flow rate control device for a pump as claimed in claim 1, wherein said central shaft member has a pipe passageway formed therein, through which said output chamber communicates with said pump pressure chamber.

5. A flow rate control device for a pump as claimed in claim 1, wherein said central shaft member is solid.

6. A flow rate control device for a pump as claimed in claim 1, wherein said spool valve is integrated with said central shaft member.

7. A flow rate control device for a pump as claimed in claim 1, wherein said central shaft member is fixed to said housing.

8. A flow rate control device for a pump as claimed in claim 7, wherein said central shaft member has a pipe passageway formed therein.

9. A flow rate control device for a pump as claimed in claim 8, wherein, as the sleeve member moves axially, an opening of the pipe passageway formed in said central shaft member is changed in area.

10. A flow rate control device for a pump as claimed in claim 8, wherein an arcuate slit is formed in the outer cylindrical surface of said central shaft member to form said choke tubular passageway.

* * * * *

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix B

US Patent 4,877,099 – Duffy

United States Patent [19]

Duffy

[11] **Patent Number: 4,877,099**

[45] **Date of Patent: * Oct. 31, 1989**

[54] **ELECTRONICALLY CONTROLLED VARIABLE ASSIST POWER STEERING SYSTEM**

[75] Inventor: **James J. Duffy, Livonia, Mich.**

[73] Assignee: **Ford Motor Company, Dearborn, Mich.**

[*] Notice: The portion of the term of this patent subsequent to Aug. 2, 2005 has been disclaimed.

[21] Appl. No.: **209,162**

[22] Filed: **Jun. 17, 1988**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 902,919, Sep. 2, 1986, Pat. No. 4,760,892.

[51] **Int. Cl.**[4] **B62D 5/08**

[52] **U.S. Cl.** **180/142**; 180/148; 137/625.65; 251/30.05

[58] **Field of Search** 180/141, 142, 143, 147, 180/148, 132; 137/625.65; 251/30.02, 30.05

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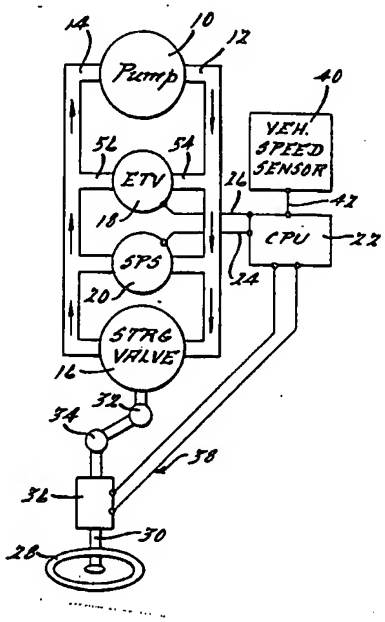
Primary Examiner—Charles A. Marmor
Assistant Examiner—Tamara L. Finlay
Attorney, Agent, or Firm—Donald J. Harrington; Keith L. Zerschling

[57] **ABSTRACT**

A power steering gear for a vehicle capable of providing a variable degree of power assistance to supplement manual steering effort wherein the variable assist is achieved by controlling directly the magnitude of the steering pressure made available to a pressure operated motor by a vehicle engine driven pump, the magnitude of the pressure being controlled by a central processing unit that responds to vehicle steering wheel torque and vehicle speed to produce an appropriate steering pressure and power assist for all driving conditions.

5 Claims, 6 Drawing Sheets



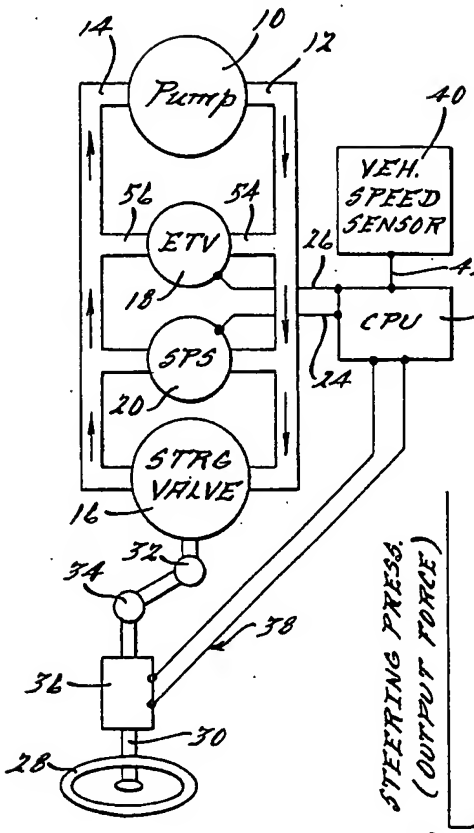


Fig. 1.

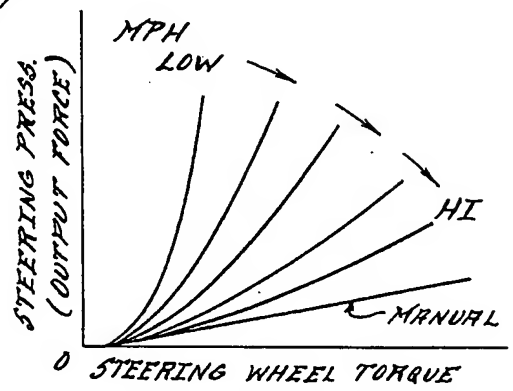


Fig. 2.

Fig. 3.

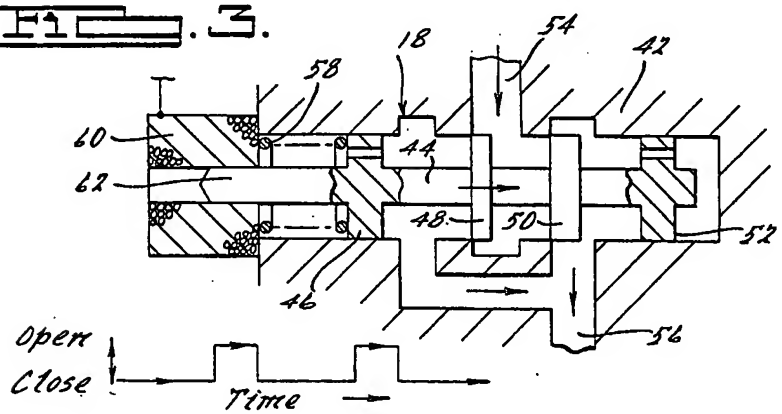


Fig. 3A.

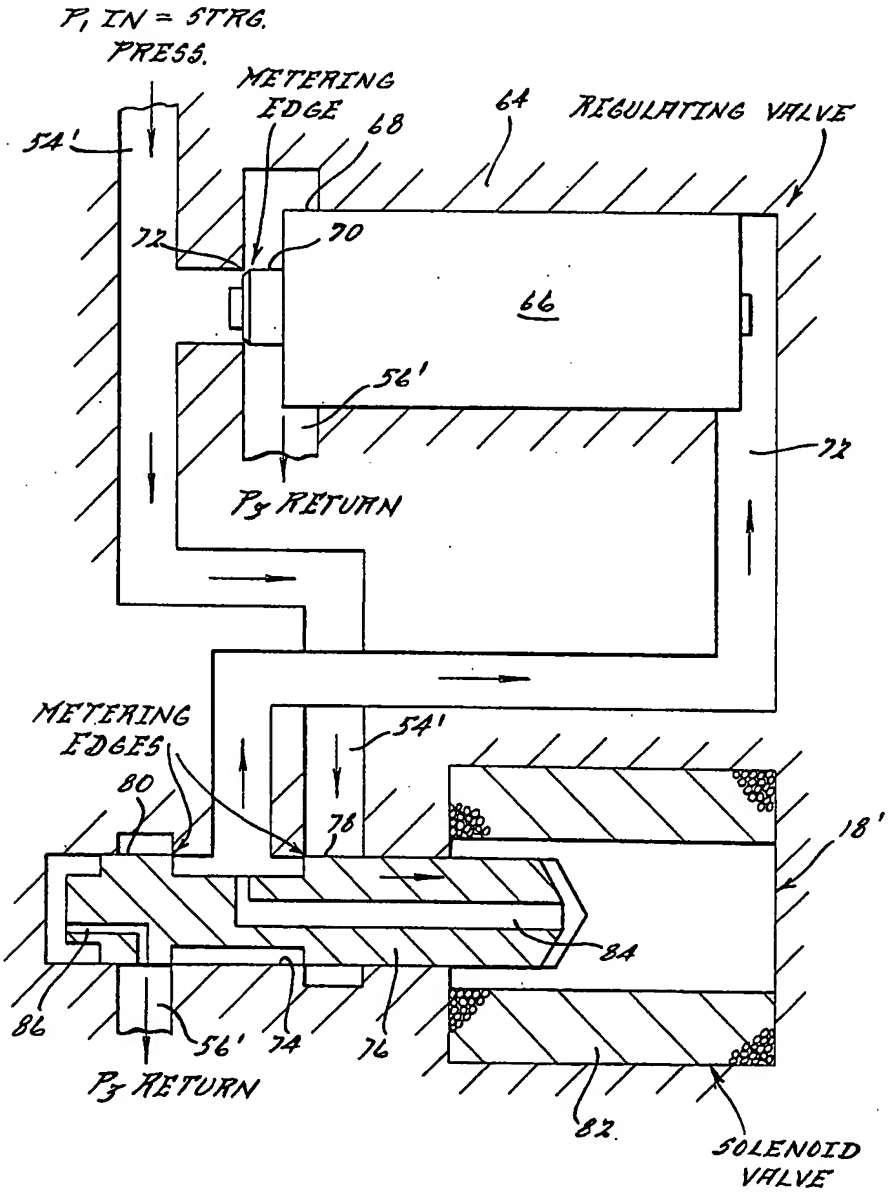


FIG. 4

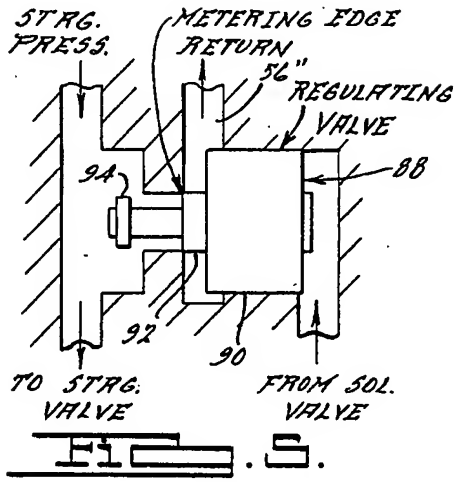


FIG. 5.

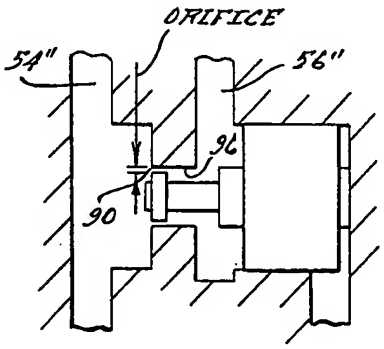


FIG. 5A.

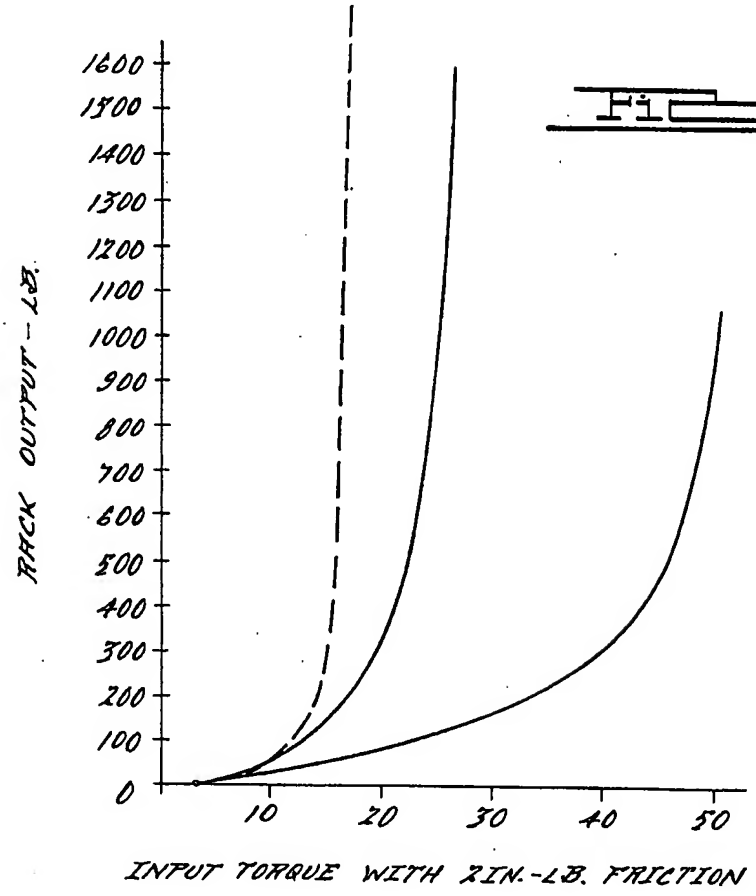


FIG. 5B.

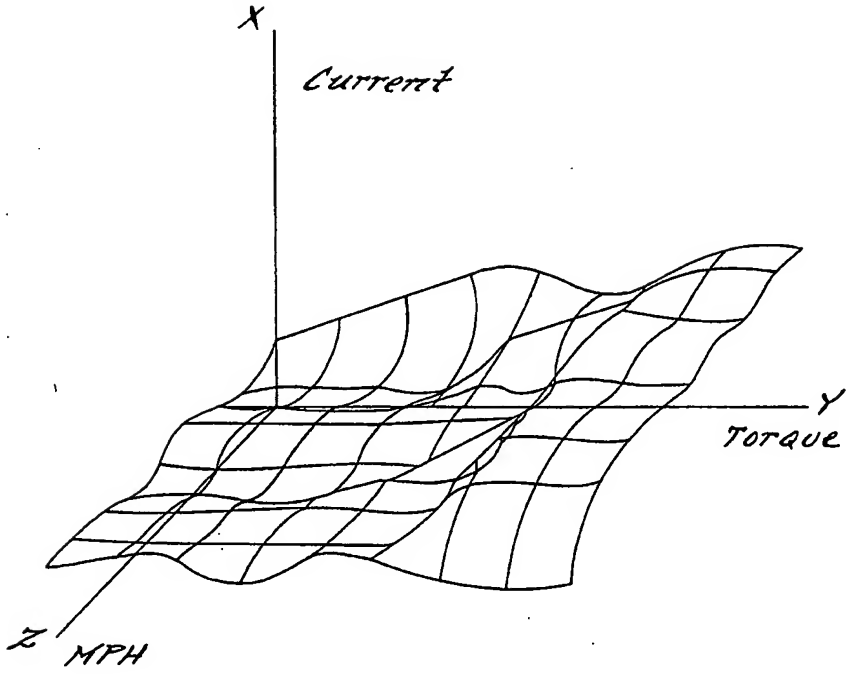
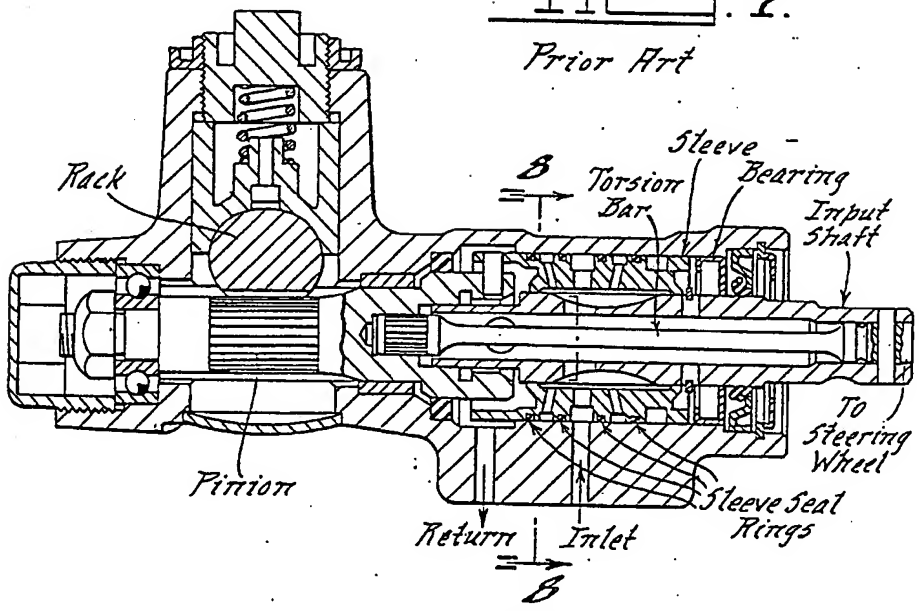


Fig. 6.

Fig. 7.
Prior Art



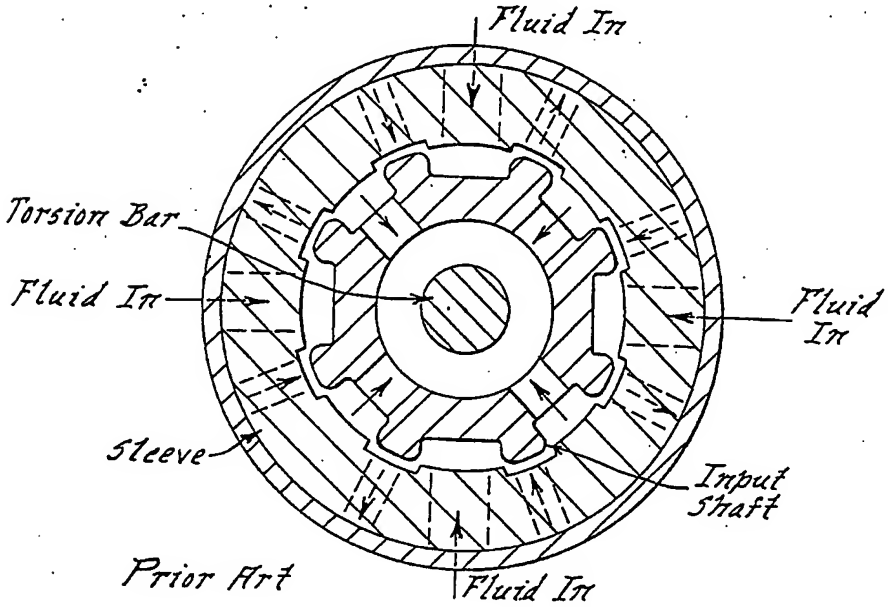
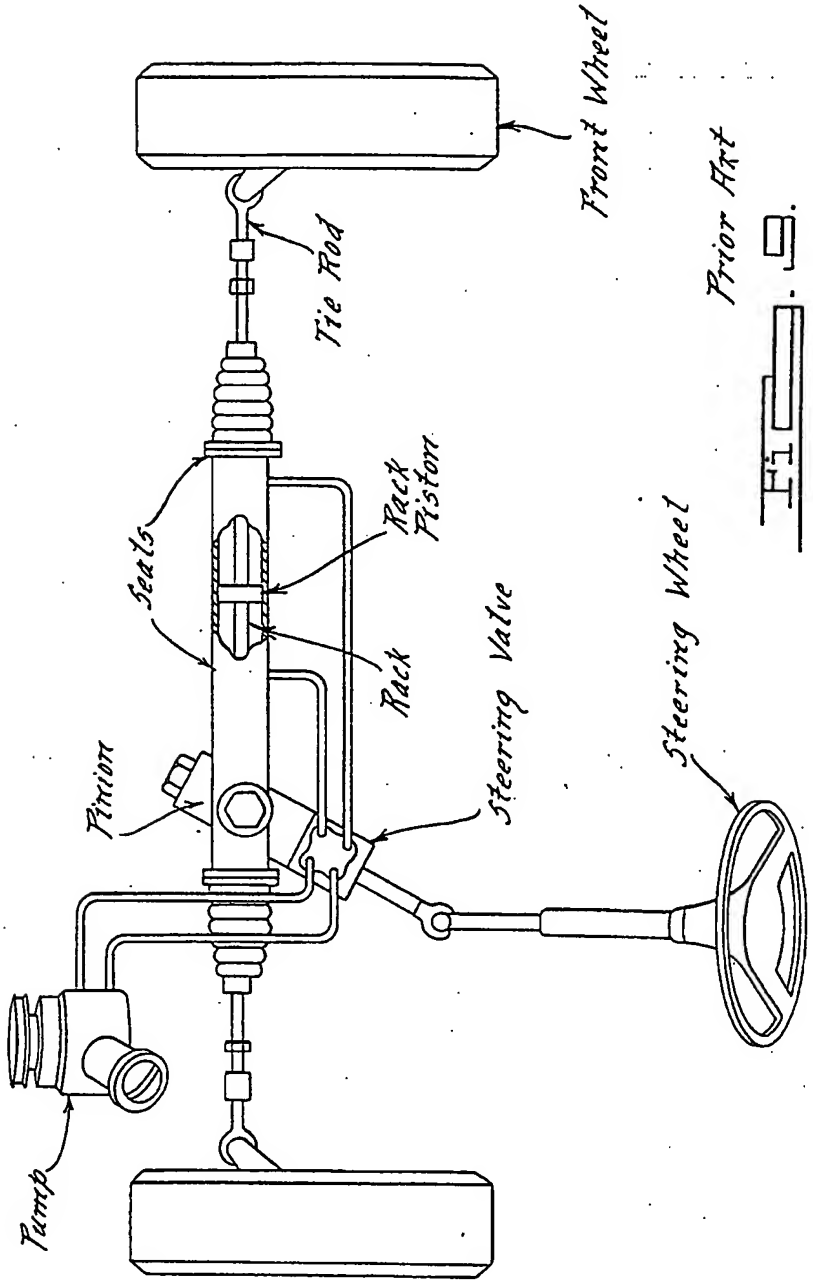


Fig. 8.



Prior Art

Fig. 9.

ELECTRONICALLY CONTROLLED VARIABLE ASSIST POWER STEERING SYSTEM

REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of U.S. patent application Ser. No. 902,919, filed Sept. 2, 1986 now U.S. Pat. No. 4,760,882. That application is assigned to the assignee of the present application.

BACKGROUND OF THE INVENTION

My invention comprises a variable assist power steering gear system for use in automotive vehicles wherein the desired steering pressure for any given steering torque and vehicle speed is controlled instantaneously by an onboard microprocessor unit. My invention is adapted particularly to be used in a rack and pinion steering gear system of the kind disclosed in my Pat. Nos. 4,516,471; 4,485,883; 4,063,490 and 4,561,521.

In each of these prior art power steering gear mechanisms a gear rack is adjustable in the direction of its axis. The rack is connected to the steering gear linkage of a wheeled vehicle and is engaged by a drive pinion connected to a driver controlled steering shaft by a torsion bar. When the vehicle operator applies a steering torque to the steering shaft, the torsion bar deflects as driving torque is distributed to the pinion.

The pinion is connected to a valve sleeve of a rotary steering valve assembly, and the steering shaft is connected to an inner valve element within the valve sleeve. Upon deflection of the torsion bar the inner valve element of the rotary valve assembly is adjusted with respect to the rotary valve sleeve. This valve adjustment controls pressure distribution to each of two fluid pressure working chambers of a fluid motor that applies a fluid pressure force to the rack to effect a power assist.

The fluid pressure pump in a steering system of this type is a positive displacement pump that has a flow control valve to provide a constant flow rate. Steering pressure is varied by controlling the effective fluid flow area through the steering valve, and that area in turn is determined by the degree of deflection of the torsion bar.

In the arrangement shown by Pat. No. 4,561,521, I have provided a dual flow delivery path to the steering valve, one path being defined in part by a speed sensitive bypass valve. The effective flow area through the bypass valve is proportional to vehicle speed so that a reduced flow occurs when the vehicle is operated at high speeds and relatively high flow occurs when the vehicle is operated at low speeds or when the vehicle operator is engaged in parking maneuvers. The bypass valve is controlled by an electric actuator which in turn is controlled by a vehicle speed sensitive electronic module.

GENERAL DESCRIPTION OF THE INVENTION

My present invention is distinguished from the invention of Pat. No. 4,561,521 because the variable assist feature is achieved by regulating directly the steering pressure rather than by controlling the flow area of the valve which would in turn affect the steering pressure.

The variable assist power steering gear mechanism of my present invention uses a simplified rotary valve that may employ valve elements common to valve elements of the kind described in my earlier patents, above identified, without a major change in the shape of the valve housing and without significant capital investments for tooling and facilities for its manufacture for automotive vehicles.

My system includes an electronically actuated area control valve located between the supply and return lines of the positive displacement pump. This controls the rate at which fluid is bypassed from the high pressure side of the pump to the low pressure side. The corresponding valves of FIGS. 4, 5 and 5A of the aforementioned Pat. No. 4,760,892 respond to the pressure differential forces acting on the valves to control the steering pressure. It includes also input torque and vehicle speed sensors which cooperate with a microprocessor unit, the latter controlling the steering assist made available by the steering gear by sending a controlled current to the area control valve in accordance with a preset program in the processing unit. The electronic area control valve acts as an auxiliary steering gear valve in parallel hydraulically with the rotary steering valve assembly as in the case of Pat. No. 4,561,521. Whenever the electronic area control valve is functioning and bypassing fluid through the parallel flow circuit, the steering pressure is lower than the pressure that would exist if the electronic area control valve were closed.

The microprocessor unit can be programmed with a complete vehicle steering control parameter map which makes it possible to anticipate all possible driving conditions so that an optimum steering pressure for any driving condition is made available. Thus for each steering wheel torque and for each corresponding road speed there is an optimum steering assist made available to the rack and pinion gear mechanism.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

FIG. 1 is a schematic representation of a fluid circuit for a rack and pinion steering gear assembly embodying my invention.

FIG. 2 is a performance chart for my improved steering gear system showing the relationship between steering wheel torque and steering assist for a series of road speeds.

FIG. 3 is a sub-assembly view of an electronic throttling valve for use in the circuit of FIG. 1.

FIG. 3A is a graph showing the shape of the voltage input wave for the solenoid of the valve of FIG. 3.

FIG. 4 is a sub-assembly view of an alternative electronic pressure control valve for use in the circuit of FIG. 1.

FIG. 5 is a detail view of a second alternative electronic pressure control valve in its normal regulating position.

FIG. 5A is a view similar to FIG. 5 wherein the valve is in the position corresponding to an inoperative condition of the electronic pressure control valve.

FIG. 5B is a graph for an actual working embodiment of the invention showing the relationship between steering shaft torque and steering gear output torque for a closed EPC valve and for normal operation at zero vehicle speed and for a vehicle speed of 80 MPH.

FIG. 6 is a three-dimensional representation of a control data map for a vehicle steering installation that may be programmed into the microprocessor for my improved steering system.

FIG. 7 is a cross-sectional schematic view of a prior art rotary-valve, rack and pinion steering gear with explanatory labels.

FIG. 8 is a cross-sectional view of the prior art rotary valve of FIG. 7 with explanatory labels.

FIG. 9 is a schematic view of a prior art installation drawing in schematic form showing a steering gear fluid motor and dirigible wheel linkages together with explanatory labels.

PARTICULAR DESCRIPTION OF THE INVENTION

In FIG. 1, numeral 10 designates a power steering pump driven by the vehicle engine. It provides a constant flow in outlet passage 12, and it is supplied with fluid through a supply passage 14. A steering valve assembly 16 has an inlet connected to the passage 12. The return flow line for the steering valve assembly is the supply passage 14 for the pump 10.

Located in parallel relationship with respect to the pump 10 is an electronically controlled throttling valve 18. It is effective to bypass fluid from passage 12 to passage 14 before the fluid reaches steering valve assembly 16. Situated in parallel with the pump 10 and the electric throttling valve 18 is a steering pressure sensor 20 which is used if enhanced steering assist control is desired. Sensor 20 is in communication with a microprocessor or central processor unit (CPU) identified by reference numeral 22, electric connections being shown at 24 and 26 whereby the central processor unit 22 is part of a closed loop system. The sensor detects when a pressure dictated by the speed sensor 40 is established by the throttling valve 18 as the latter responds to the output of the central processing unit.

The vehicle operator, during steering maneuvers, applies a steering torque to steering wheel 28, which is connected to steering shaft 30. Shaft 30 in turn is connected to the driving pinion of a power steering rack and pinion gear through a torsion bar in the usual fashion. The torque flow path from the shaft 30 to the steering valve assembly includes a linkage mechanism that may include U-joints 32 and 34 and a steering wheel torque and angle sensor 36. The sensor 36 develops a signal which is distributed to CPU 22 through electric wiring 38. Vehicle speed sensor 40 develops an electric signal that is distributed to the CPU 22 through wiring 42.

The electronic throttling valve may be a pulse width modulator controlled variable orifice which is governed by CPU 22. Steering pressure is determined by the equation:

$$P = \frac{K \cdot Q^2}{CA}$$

where P is the steering gear piston differential pressure, Q is the rate of flow developed by the pump and A is the sum of the effective throttling areas of steering valve assembly 16 and electronic throttling valve 18.

The steering pressure sensor 20 senses the steering valve inlet pressure minus the outlet pressure, which is approximately the same as the piston differential pressure of the fluid motor for the steering gear system. The electronic throttling valve is designed so that it is able to change pressure to any desired value by changing throttling area of the steering valve assembly.

A so-called map of the desired relationship of the steering pressure with respect to the other sensed inputs for the CPU 22 is programmed into the CPU 22. Thus, for example, steering efforts may be increased as vehicle speed increases by reducing pressure. If it is desired to provide a manual steering effect, that can correspond to a zero steering pressure signal at the desired speed. At higher speeds the pump may be disconnected from the engine for maximum fuel economy.

By locating the electronic torque sensor between the steering wheel and the U-joints 34 and 32, the U-joint friction becomes output friction instead of input friction; that is, it does not cause the steering pressure control system to sense the friction as an input torque. Thus incremental pressure due to the internal friction of the U-joints does not resist the so-called returnability of the steering gear to a straight ahead driving condition following a steering maneuver.

A first embodiment of the steering assist valve of my invention is shown in detail in FIG. 3. It includes a valve sleeve 42 having internal valve lands and a valve spool 44 with external valve lands. Valve spool 44 has external lands 46, 48, 50 and 52 which register with corresponding internal lands of the sleeve 42. Fluid from the passage 12 is distributed to the electronic throttling valve 18 through passage 54, and fluid is returned from valve 18 to the passage 14 through valve passage 56.

Spool 44 is biased in a right hand direction as seen in FIG. 3 by valve spring 58. A solenoid 60 surrounds solenoid armature 62 which is connected to valve spool 44. When the windings of the solenoid 60 are energized, valve spool 44 moves to the left thereby restricting the degree of communication between passage 54 and 56. When the current in the solenoid windings is decreased, spring 58 moves valve to the right thereby opening communication between passage 54 and 56. A greater volume of fluid is bypassed through the electronic throttling valve 18 as the valve spool 44 moves to the right and the steering pressure decreses. Thus the magnitude of the manual steering effort increases.

The shape of the signal made available to the solenoid is illustrated schematically in FIG. 3A. This is a pulse width modulated electric voltage signal. To increase the effective force acting in a left hand direction to oppose spring 58, the time of each pulse is increased so that the effective force acting in left hand direction on valve spool 44 is increased.

In FIG. 2 I have illustrated the relationship between steering wheel torque and steering pressure or output force for any given vehicle speed. The relationship is generally parabolic. As speed inreses, the magnitude of the slopes of the parabolas decrease. The information illustrated schematically in FIG. 2 can be programmed into the CPU 22 so that it will respond with an appropriate signal for the electronic throttling valve as torque signals and speed signals are distributed to it from sensor 36 and sensor 40, respectively.

In FIG. 4 I have illustrated a pressure differential sensitive electronic throttling valve design. The valve sleeve 42 and the valve spool 44 of FIG. 3 have been replaced in FIG. 4 with a simplified valve sleeve 64 and a simplified valve spool 66. The latter has a first large diameter land 68 and small diameter land 70. The metering edge of land 70 can be chamfered as shown at 71.

The input passage for the electric throttling valve of FIG. 4 is shown at 54' and the return passage is shown at 56'. These passages correspond respectively to passages 54 and 56 of the FIG. 3 embodiment.

Land 70 controls the degree of communication between passage 54' and return passage 56'. The pressure in passage 56' acts on the large diameter area of land 68 and creates a pressure force acting in a right hand direction on the valve element 66 as seen in FIG. 4. That area is equal to the area of the right hand end of the valve element 66 minus the area of land 70. Valve sleeve 64 has a closed end at the right hand side of the element 66. That area is subjected to the pressure in passage 72 which communicates with a port in valve sleeve 74 of solenoid valve 18'.

Solenoid valve 18' comprises a valve spool 76 having external lands 78 and 80 that register with internal lands of the valve sleeve 74. Return passage 56', which may be common to the return passage for the regulating valve sleeve 64, register with land 80. Land 78 register with the valve port defined by the internal lands of sleeve 74 which communicate with passage 54'. Passage 72 communicates with a port in sleeve 74 at a location intermediate lands 78 and 80.

The right hand end of the spool 76 forms an armature for windings of solenoid 82. Valve element 76 is internally ported at 84 to distribute pressure in passage 72 to the right hand end of the valve element 76. Thus the pressure in passage 72 acts on the right hand end of the valve element 76.

The return pressure in passage 56' is distributed to the left hand end of the valve spool 76 through internal port 86.

The windings for solenoid 82 are supplied with current from CPU 22 as in the embodiment described with reference to FIG. 3. The bypass flow is controlled by the regulating valve spool 66, and the valve spool 76 functions merely as a pilot valve that controls the operation of the valve spool 66. Pilot valve 76 in turn responds to the force of the solenoid valve 18'. The forces required for the solenoid valve are greatly reduced by reason of the use of a pilot valve in combination with the regulator valve. This simplifies the design of the solenoid valve and reduces its cost while improving reliability of the overall system. Exact linearity in the relationship of the current in the solenoid windings with respect to the pressure differential between the supply pressure in passage 54 and the return pressure in passage 56 is not required.

In FIGS. 5 and 5A I have illustrated an alternate regulating valve design that may be used in lieu of the valve 66 of FIG. 4. The regulating valve of FIGS. 5 and 5A includes a valve spool 88 having a large diameter land 90 and a small diameter land 92. In addition a secondary land 94 slightly less in diameter than land 92 is formed on the spool 88 at a location spaced from land 92. Pressure from the solenoid valve, as in the case of the FIG. 4 embodiment, is distributed to the right hand side of the regulating valve spool 88. The pressure in the return passage, which is identified by reference character 56'' in FIGS. 5 and 5A, is equal to the difference between the area of the right hand side of the valve 88 and the area of land 92.

The valve of FIG. 5 and 5A function in a manner similar to the function of the valve 66 of FIG. 4 insofar as the lands 90 and 92 are concerned. If there is a failure in the electrical circuit for the solenoid valve or if the circuit breaker for the circuit supplying the steering system should open, the solenoid magnetic force is eliminated and pressure in passage 56' becomes equal to the pressure acting on the right hand side of the valve 88. This condition is shown in FIG. 5A. Thus the valve 88 is stroked in a right hand direction. In that condition, land 94 registers with internal land 96 of the regulating valve, the diameter of land 94 being slightly less than the diameter of land 96. Thus an orifice 98 is created which allows a fixed flow from passage 54'' to passage 56'' which correspond respectively to passages 54' and 56' of FIG. 4. The area of the orifice 98 is chosen so that a medium power steering pressure assist is achieved thereby eliminating an undesirable harsh transition from a power assist mode to a fully manual steering mode when the control voltage is interrupted.

In FIG. 6 I have shown a three dimensional plot of the relationship between the output of the central processing unit represented by electric current plotted on first axis "X", steering torque applied by operator to the torsion bar plotted on second axis "Y" and vehicle speed in miles per hour plotted on third axis "Z". FIG. 6 is a control data map which can be programmed into the memory of CPU 22. For any given relationship between torque and speed there is an optimum current distributed through electric lead 26 to the electronically controlled throttling valve 18. The data points in 56 define a surface a three dimensions as shown.

Having described a preferred embodiment of my invention, what I claim and desire to secure by U.S. Letters Patents is:

1. In a power steering system for an automotive vehicle having a tooth member adapted to be connected to a vehicle steering linkage, a driving member engageable with said gear tooth member, a driver controlled steering shaft and torsion bar connection between said steering shaft and said driving member whereby steering forces are distributed from said steering shaft to said gear tooth member;

a rotary valve assembly comprising a valve sleeve connected to and rotatable with said driving member, an inner valve element received in said valve sleeve and connected to and rotatable with said steering shaft;

a power steering pump, hydraulic pressure operated fluid motors having a pressure operated member connected to said gear tooth member whereby a fluid pressure force may be applied to said gear tooth member to supplement the manual steering effort, thereby providing the vehicle operator with a power assist;

a fluid pressure circuit connecting said pump to said fluid motor, said steering valve assembly being located in and defining in part said fluid pressure circuit whereby pressure is distributed to either one side of said fluid motor or the other depending upon the direction of torque applied to said steering shaft, said fluid pressure circuit comprising a high pressure passage connecting a high pressure side of said pump to the inlet side of said steering valve assembly and a low pressure return flow passage connecting the outlet side of said steering valve assembly with the inlet side of said pump;

an electronically controlled throttling valve located in parallel disposition in said fluid pressure circuit between the inlet side of said pump and the outlet side of said pump whereby a bypass flow path is established in parallel relationship with respect to the fluid flow path through said steering valve assembly;

an electronic central processor unit connected to said electronically controlled throttling valve, a steering torque sensor connected to said central proces-

sor unit, a steering pressure sensor in said hydraulic pressure circuit connected to said central processor unit;

a vehicle speed sensor connected to said central processor unit, said central processor unit having an electronic memory with stored vehicle speed, steering torque and steering pressure data, the relationship between said data indicating the optimum electrical voltage signal which when distributed to the electronically controlled throttle valve effects a controlled bypass of fluid from the high pressure side of said pump to the inlet side of said pump thereby effecting a controlled power assist that depends upon vehicle speed;

said electronically controlled throttling valve comprises a valve spool and a valve sleeve surrounding said valve spool, said sleeve and said spool being ported to effect controlled communication between the high pressure side of said pump and the low pressure side of said pump, and spring means for biasing said valve spool in one direction and a solenoid having windings surrounding an armature connected to said valve spool whereby displacement of said valve spool against the opposing force of said spring is dependent upon the output signal of said central processing unit, the magnitude of said output signal being determined by the magnitude of the vehicle speed sensor signal and the steering pressure sensor signal.

2. The combination as set forth in claim 1 wherein said electronically controlled throttling valve comprises a valve spool and a valve sleeve surrounding said valve spool, said sleeve and said spool being ported to effect controlled communication between the high pressure side of said pump and the low pressure side of said pump, spring means for biasing said valve spool in one direction and a variable force solenoid having windings surrounding an armature connected to said valve spool whereby displacement of said valve spool against the opposing force of said spring is dependent upon the output signal of said central processing unit, the magnitude of said output signal being determined by the magnitude of the vehicle speed sensor signal and the steering pressure sensor signal.

3. In a power steering system for an automotive vehicle having a tooth member adapted to be connected to a vehicle steering linkage, a driving member engageable with said gear tooth member, a driver controlled steering shaft and torsion bar connection between said steering shaft and said driving member whereby steering forces are distributed from said steering shaft to said gear tooth member;

a rotary valve assembly comprising a valve sleeve connected to and rotatable with said driving member, an inner valve element received in said valve sleeve and connected to and rotatable with said steering shaft;

a power steering pump, hydraulic pressure operated fluid motors having a pressure operated member connected to said gear tooth member whereby a fluid pressure force may be applied to said gear tooth member to supplement the manual steering effort, thereby providing the vehicle operator with a power assist;

a fluid pressure circuit connecting said pump to said fluid motor, said steering valve assembly being located in and defining in part said fluid pressure circuit whereby pressure is distributed to either one side of said fluid motor or the other depending upon the direction of torque applied to said steering shaft, said fluid pressure circuit comprising a high pressure passage connecting a high pressure side of said pump to the inlet side of said steering valve assembly and a low pressure return flow passage connecting the outlet side of said steering valve assembly with the inlet side of said pump;

an electronically controlled throttling valve located in parallel disposition in said fluid pressure circuit between the inlet side of said pump and the outlet side of said pump whereby a bypass flow path is established in parallel relationship with respect to the fluid flow path through said steering valve assembly;

an electronic central processor unit connected to said electronically controlled throttling valve, a steering torque sensor connected to said central processor unit;

a vehicle speed sensor connected to said central processor unit, said central processor unit having an electronic memory with stored vehicle speed, steering torque and steering pressure data, the relationship between said data indicating the optimum electrical voltage signal which when distributed to the electronically controlled throttle valve effects a controlled bypass of fluid from the high pressure side of said pump to the inlet side of said pump thereby effecting a controlled power assist that depends upon vehicle speed;

said electronically controlled throttling valve comprising a regulating valve having a regulating valve sleeve and a regulating valve spool located in said sleeve, a metering orifice having one side thereof communicating with the outlet side of said pump and the downstream side thereof communicating with the low pressure side of said pump, said regulating valve spool registering with said metering orifice and controlling its effective area as it is shifted within said regulating valve sleeve, a solenoid valve comprising a solenoid valve spool and a solenoid valve sleeve receiving said solenoid valve spool, said solenoid valve sleeve and solenoid valve spool having registering valve lands that define in part said fluid pressure circuit on the high pressure side of said pump and the fluid pressure circuit on the low pressure side of said pump, a fluid passage connecting one side of said regulating valve spool with said solenoid valve sleeve, said solenoid valve spool upon movement relative to said solenoid valve sleeve controlling the degree of communication between the high pressure side of said pump and said passage and the degree of communication between said passage and the return side of said pump, pressure distributor passages connecting said passage with one end of said solenoid valve spool and connecting the other end of said solenoid valve spool with the low pressure side of said pump, solenoid valve windings surrounding a solenoid armature connected to the solenoid valve spool whereby displacement of said solenoid valve spool relative to said solenoid valve sleeve is determined by the magnitude of the electromagnetic force developed by said solenoid windings, said solenoid windings being connected to said central processor unit, said solenoid valve spool thereby functioning as a pilot valve that triggers the operation of said regulation valve.

4. In a power steering system for an automotive vehicle having a tooth member adapted to be connected to a vehicle steering linkage, a driving member engageable with said gear tooth member, a driver controlled steering shaft and torsion bar connection between said steering shaft and said driving member whereby steering forces are distributed from said steering shaft to said gear tooth member;

a rotary valve assembly comprising a valve sleeve connected to and rotatable with said driving member, an inner valve element received in said valve sleeve and connected to and rotatable with said steering shaft;

a power steering pump, hydraulic pressure operated fluid motors having a pressure operated member connected to said gear tooth member whereby a fluid pressure force may be applied to said gear tooth member to supplement the manual steering effort, thereby providing the vehicle operator with a power assist;

a fluid pressure circuit connecting said pump to said fluid motor, said steering valve assembly being located in and defining in part said fluid pressure circuit whereby pressure is distributed to either one side of said fluid motor or the other depending upon the direction of torque applied to said steering shaft, said fluid pressure circuit comprising a high pressure passage connecting a high pressure side of said pump to the inlet side of said steering valve assembly and a low pressure return flow passage connecting the outlet side of said steering valve assembly with the inlet side of said pump;

an electronically controlled throttling valve located in parallel disposition in said fluid pressure circuit between the inlet side of said pump and the outlet side of said pump whereby a bypass flow path is established in parallel relationship with respect to the fluid flow path through said steering valve assembly;

an electronic central processor unit connected to said electronically controlled throttling valve, a steering torque sensor connected to said central processor unit;

a vehicle speed sensor connected to said central processor unit, said central processor unit having an electronic memory with stored vehicle speed, steering torque and steering pressure data, the relationship between said data indicating the optimum electrical voltage signal which when distributed to the electronically controlled throttle valve effects a controlled bypass of fluid from the high pressure side of said pump to the inlet side of said pump thereby effecting a controlled power assist that depends upon vehicle speed;

said electronically controlled throttling valve comprising a regulating valve having a regulating valve sleeve and a regulating valve spool located in said sleeve, a metering orifice having one side thereof communicating with the outlet side of said pump and the downstream side thereof communicating with the low pressure side of said pump, said regulating valve spool registering with said metering orifice and controlling its effective area as it is shifted within said regulating valve sleeve, a solenoid valve comprising a solenoid valve spool and a solenoid valve sleeve receiving said solenoid valve spool, said solenoid valve sleeve and solenoid valve spool having registering valve lands that define in part said fluid pressure circuit on the high pressure side of said pump and the fluid pressure circuit on the low pressure side of said pump, a fluid passage connecting one side of said regulating valve spool with said solenoid valve sleeve, said solenoid valve spool upon movement relative to said solenoid valve sleeve controlling the degree of communication between the high pressure side of said pump and said passage and the degree of communication between said passage and the return side of said pump, pressure distributor passages connecting said passage with one end of said solenoid valve spool and connecting the other end of said solenoid valve spool with the low pressure side of said pump, solenoid valve windings surrounding a solenoid armature connected to the solenoid valve spool whereby displacement of said solenoid valve spool relative to said solenoid valve sleeve is determined by the magnitude of the electromagnetic force developed by said solenoid windings, said solenoid windings being connected to said central processor unit, said solenoid valve spool thereby functioning as a pilot valve that triggers the operation of said regulating valve;

said regulating valve spool comprising two regulating valve lands of differential diameter, the smaller of said regulating valve lands registering with said orifice and effective to control the effective area of said orifice depending upon the differential fluid pressures acting on said regulating valve spool, an auxiliary land formed on said regulating valve spool of slightly lesser diameter than the smaller regulating valve land of said regulating valve spool, said auxiliary land moving into registry with said orifice when said regulating valve spool is shifted away from said orifice thereby establishing a flow restriction between the high pressure side of said pump and the return side of said pump whereby a moderate power assist is achieved independently of the operation of said solenoid valve.

5. In a power steering system for an automotive vehicle having a tooth member adapted to be connected to a vehicle steering linkage, a driving member engageable with said gear tooth member, a driver controlled steering shaft and torsion bar connection between said steering shaft and said driving member whereby steering forces are distributed from said steering shaft to said gear tooth member;

a rotary valve assembly comprising a valve sleeve connected to and rotatable with said driving member, an inner valve element received in said valve sleeve and connected to and rotatable with said steering shaft;

a power steering pump, hydraulic pressure operated fluid motors having a pressure operated member connected to said gear tooth member whereby a fluid pressure force may be applied to said gear tooth member to supplement the manual steering effort, thereby providing the vehicle operator with a power assist;

a fluid pressure circuit connecting said pump to said fluid motor, said steering valve assembly being located in and defining in part said fluid pressure circuit whereby pressure is distributed to either one side of said fluid motor or the other depending upon the direction or torque applied to said steering shaft, said fluid pressure circuit comprising a high pressure passage connecting a high pressure

side of said pump to the inlet side of said steering valve assembly and a low pressure return flow passage connecting the outlet side of said steering valve assembly with the inlet side of said pump;

an electronically controlled throttling valve located in parallel disposition in said fluid pressure circuit between the inlet side of said pump and the outlet side of said pump whereby a bypass flow path is established in parallel relationship with respect to the fluid flow path through said steering valve assembly;

an electronic central processor unit connected to said electronically controlled throttling valve, a steering torque sensor connected to said central processor unit;

a vehicle speed sensor connected to said central processor unit, said central processor unit having an electronic memory with stored vehicle speed, steering torque and steering pressure data, the relationship between said data indicating the optimum electrical voltage signal which when distributed to the electronically controlled throttle valve effects a controlled bypass of fluid from the high pressure side of said pump to the inlet side of said pump thereby effecting a controlled power assist that depends upon vehicle speed;

said electronically controlled throttling valve comprising a regulating valve having a regulating valve sleeve and a regulating valve spool located in said sleeve, a metering orifice having one side thereof communicating with the outlet side of said pump and the downstream side thereof communicating with the low pressure side of said pump, said regulating valve spool registering with said metering orifice and controlling its effective area as it is shifted within said regulating valve sleeve, a solenoid valve comprising a solenoid valve spool and a solenoid valve sleeve receiving said solenoid valve spool, said solenoid valve sleeve and solenoid valve spool having registering valve lands that define in part said fluid pressure circuit on the high pressure side of said pump and the fluid pressure circuit on the low pressure side of said pump, a fluid passage connecting one side of said regulating valve spool with said solenoid valve sleeve, said solenoid valve spool upon movement relative to said solenoid valve sleeve controlling the degree of communication between the high pressure side of said pump and said passage and the degree of communication between said passage and the return side of said pump, pressure distributor passages connecting said passage with one end of said solenoid valve spool and connecting the other end of said solenoid valve spool with the low pressure side of said pump, solenoid valve windings surrounding a solenoid armature connected to the solenoid valve spool whereby displacement of said solenoid valve spool relative to said solenoid valve sleeve is determined by the magnitude of the electromagnetic force developed by said solenoid windings, said solenoid windings being connected to said central processor unit, said solenoid valve spool thereby functioning as a pilot valve that triggers the operation of said regulating valve;

said regulating valve spool comprising two regulating valve lands of differential diameter, the smaller of said regulating valve lands registering with said orifice and effective to control the effective area of said orifice depending upon the differential fluid pressures acting on said regulating valve spool, an auxiliary land formed on said regulating valve spool of slightly lesser diameter than the smaller regulating valve land of said regulating valve spool, said auxiliary land moving into registry with said orifice when said regulating valve spool is shifted away from said orifice thereby establishing a flow restriction between the high pressure side of said pump and the return side of said pump whereby a moderate power assist is achieved independently of the operation of said solenoid valve;

said auxiliary land upon movement of said regulating valve spool away from said orifice registering with said orifice and establishing therewith an annular opening surrounding said auxiliary land that creates an effective orifice of smaller area than the effective flow area of said orifice when the smaller flow metering land of said regulating valve spool moves away from said orifice.

* * * * *

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix C

MPEP §706.02(j) Contents of a 35 U.S.C. 103 Rejection

35 U.S.C. 103 authorizes a rejection where, to meet the claim, it is necessary to modify a single reference or to combine it with one or more other references. After indicating that the rejection is under 35 U.S.C. 103, the examiner should set forth in the Office action:

(A) the relevant teachings of the prior art relied upon, preferably with reference to the relevant column or page number(s) and line number(s) where appropriate,

(B) the difference or differences in the claim over the applied reference(s),

(C)the proposed modification of the applied reference(s) necessary to arrive at the claimed subject matter, and

(D) an explanation why one of ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck,* 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP § 2143- § 2143.03 for decisions pertinent to each of these criteria.

The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). See MPEP § 2144 - § 2144.09 for examples of reasoning supporting obviousness rejections.

Where a reference is relied on to support a rejection, whether or not in a minor capacity, that reference should be positively included in the statement of the rejection. See *In re Hoch,* 428 F.2d 1341, 1342 n.3 166 USPQ 406, 407 n. 3 (CCPA 1970).

> It is important for an examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply. Furthermore, if an initially rejected application issues as a patent, the rationale behind an earlier rejection may be important in interpreting the scope of the patent claims. Since issued patents are presumed valid (35 U.S.C. 282) and constitute a property right (35 U.S.C. 261), the written record must be clear as to the basis for the grant. Since patent examiners cannot normally be compelled to testify in legal proceedings regarding their mental processes (see MPEP § 1701.01), it is important that the written record clearly explain the rationale for decisions made during prosecution of the application.

See MPEP § 2141 - § 2144.09 generally for guidance on patentability determinations under 35 U.S.C. 103, including a discussion of the requirements of *Graham v. John Deere*, 383 U.S. 1, 148 USPQ 459 (1966). See MPEP § 2145 for consideration of applicant's rebuttal arguments. See MPEP § 706.02(l) - § 706.02(l)(3) for a discussion of prior art disqualified under 35 U.S.C. 103(c).

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix D

KSR International Co. v. Teleflex, Inc. 550 U.S. ____ (2007)

No. 04-1350, Decided April 30. 2007.

Syllabus

NOTE: Where it is feasible, a syllabus (headnote) will be released, as is being done in connection with this case, at the time the opinion is issued. The syllabus constitutes no part of the opinion of the Court but has been prepared by the Reporter of Decisions for the convenience of the reader. See *United States* v. *Detroit Timber & Lumber Co.*, 200 U. S. 321, 337.

SUPREME COURT OF THE UNITED STATES

Syllabus

KSR INTERNATIONAL CO. *v.* TELEFLEX INC. ET AL.

CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

No. 04–1350. Argued November 28, 2006—Decided April 30, 2007

To control a conventional automobile's speed, the driver depresses or releases the gas pedal, which interacts with the throttle via a cable or other mechanical link. Because the pedal's position in the footwell normally cannot be adjusted, a driver wishing to be closer or farther from it must either reposition himself in the seat or move the seat, both of which can be imperfect solutions for smaller drivers in cars with deep footwells. This prompted inventors to design and patent pedals that could be adjusted to change their locations. The Asano patent reveals a support structure whereby, when the pedal location is adjusted, one of the pedal's pivot points stays fixed. Asano is also designed so that the force necessary to depress the pedal is the same regardless of location adjustments. The Redding patent reveals a different, sliding mechanism where both the pedal and the pivot point are adjusted.

In newer cars, computer-controlled throttles do not operate through force transferred from the pedal by a mechanical link, but open and close valves in response to electronic signals. For the computer to know what is happening with the pedal, an electronic sensor must translate the mechanical operation into digital data. Inventors had obtained a number of patents for such sensors. The so-called '936 patent taught that it was preferable to detect the pedal's position in the pedal mechanism, not in the engine, so the patent disclosed a pedal with an electronic sensor on a pivot point in the pedal assembly. The Smith patent taught that to prevent the wires connecting the sensor to the computer from chafing and wearing out, the sensor should be put on a fixed part of the pedal assembly rather than in or on the pedal's footpad. Inventors had also patented self-contained modular sensors, which can be taken off the shelf and attached to any

mechanical pedal to allow it to function with a computer-controlled throttle. The '068 patent disclosed one such sensor. Chevrolet also manufactured trucks using modular sensors attached to the pedal support bracket, adjacent to the pedal and engaged with the pivot shaft about which the pedal rotates. Other patents disclose electronic sensors attached to adjustable pedal assemblies. For example, the Rixon patent locates the sensor in the pedal footpad, but is known for wire chafing.

After petitioner KSR developed an adjustable pedal system for cars with cable-actuated throttles and obtained its '976 patent for the design, General Motors Corporation (GMC) chose KSR to supply adjustable pedal systems for trucks using computer-controlled throttles. To make the '976 pedal compatible with the trucks, KSR added a modular sensor to its design. Respondents (Teleflex) hold the exclusive license for the Engelgau patent, claim 4 of which discloses a position-adjustable pedal assembly with an electronic pedal position sensor attached a fixed pivot point. Despite having denied a similar, broader claim, the U. S. Patent and Trademark Office (PTO) had allowed claim 4 because it included the limitation of a fixed pivot position, which distinguished the design from Redding's. Asano was neither included among the Engelgau patent's prior art references nor mentioned in the patent's prosecution, and the PTO did not have before it an adjustable pedal with a fixed pivot point. After learning of KSR's design for GMC, Teleflex sued for infringement, asserting that KSR's pedal system infringed the Engelgau patent's claim 4. KSR countered that claim 4 was invalid under §103 of the Patent Act, which forbids issuance of a patent when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art."

Graham v. *John Deere Co. of Kansas City*, 383 U. S. 1, 17–18, set out an objective analysis for applying §103: "[T]he scope and content of the prior art are . . . determined; differences between the prior art and the claims at issue are . . . ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." While the sequence of these questions might be reordered in any particular case, the factors define the controlling inquiry. However, seeking to resolve the obviousness question with more uniformity and consistency, the Federal Circuit has employed a "teaching, suggestion, or motivation" (TSM) test, under which a pat-

ent claim is only proved obvious if the prior art, the problem's nature, or the knowledge of a person having ordinary skill in the art reveals some motivation or suggestion to combine the prior art teachings.

The District Court granted KSR summary judgment. After reviewing pedal design history, the Engelgau patent's scope, and the relevant prior art, the court considered claim 4's validity, applying *Graham*'s framework to determine whether under summary-judgment standards KSR had demonstrated that claim 4 was obvious. The court found "little difference" between the prior art's teachings and claim 4: Asano taught everything contained in the claim except using a sensor to detect the pedal's position and transmit it to a computer controlling the throttle. That additional aspect was revealed in, *e.g.*, the '068 patent and Chevrolet's sensors. The court then held that KSR satisfied the TSM test, reasoning (1) the state of the industry would lead inevitably to combinations of electronic sensors and adjustable pedals, (2) Rixon provided the basis for these developments, and (3) Smith taught a solution to Rixon's chafing problems by positioning the sensor on the pedal's fixed structure, which could lead to the combination of a pedal like Asano with a pedal position sensor.

Reversing, the Federal Circuit ruled the District Court had not applied the TSM test strictly enough, having failed to make findings as to the specific understanding or principle within a skilled artisan's knowledge that would have motivated one with no knowledge of the invention to attach an electronic control to the Asano assembly's support bracket. The Court of Appeals held that the District Court's recourse to the nature of the problem to be solved was insufficient because, unless the prior art references addressed the precise problem that the patentee was trying to solve, the problem would not motivate an inventor to look at those references. The appeals court found that the Asano pedal was designed to ensure that the force required to depress the pedal is the same no matter how the pedal is adjusted, whereas Engelgau sought to provide a simpler, smaller, cheaper adjustable electronic pedal. The Rixon pedal, said the court, suffered from chafing but was not designed to solve that problem and taught nothing helpful to Engelgau's purpose. Smith, in turn, did not relate to adjustable pedals and did not necessarily go to the issue of motivation to attach the electronic control on the pedal assembly's support bracket. So interpreted, the court held, the patents would not have led a person of ordinary skill to put a sensor on an Asano-like pedal. That it might have been obvious to try that combination was likewise irrelevant. Finally, the court held that genuine issues of material fact precluded summary judgment.

Held: The Federal Circuit addressed the obviousness question in a narrow, rigid manner that is inconsistent with §103 and this Court's

precedents. KSR provided convincing evidence that mounting an available sensor on a fixed pivot point of the Asano pedal was a design step well within the grasp of a person of ordinary skill in the relevant art and that the benefit of doing so would be obvious. Its arguments, and the record, demonstrate that the Engelgau patent's claim 4 is obvious. Pp. 11–24.

1. *Graham* provided an expansive and flexible approach to the obviousness question that is inconsistent with the way the Federal Circuit applied its TSM test here. Neither §103's enactment nor *Graham*'s analysis disturbed the Court's earlier instructions concerning the need for caution in granting a patent based on the combination of elements found in the prior art. See *Great Atlantic & Pacific Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147, 152. Such a combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. See, *e.g.*, *United States* v. *Adams*, 383 U. S. 39, 50–52. When a work is available in one field, design incentives and other market forces can prompt variations of it, either in the same field or in another. If a person of ordinary skill in the art can implement a predictable variation, and would see the benefit of doing so, §103 likely bars its patentability. Moreover, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond that person's skill. A court must ask whether the improvement is more than the predictable use of prior-art elements according to their established functions. Following these principles may be difficult if the claimed subject matter involves more than the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement. To determine whether there was an apparent reason to combine the known elements in the way a patent claims, it will often be necessary to look to interrelated teachings of multiple patents; to the effects of demands known to the design community or present in the marketplace; and to the background knowledge possessed by a person having ordinary skill in the art. To facilitate review, this analysis should be made explicit. But it need not seek out precise teachings directed to the challenged claim's specific subject matter, for a court can consider the inferences and creative steps a person of ordinary skill in the art would employ. Pp. 11–14.

(b) The TSM test captures a helpful insight: A patent composed of several elements is not proved obvious merely by demonstrating that each element was, independently, known in the prior art. Although common sense directs caution as to a patent application claiming as

innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the art to combine the elements as the new invention does. Inventions usually rely upon building blocks long since uncovered, and claimed discoveries almost necessarily will be combinations of what, in some sense, is already known. Helpful insights, however, need not become rigid and mandatory formulas. If it is so applied, the TSM test is incompatible with this Court's precedents. The diversity of inventive pursuits and of modern technology counsels against confining the obviousness analysis by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasizing the importance of published articles and the explicit content of issued patents. In many fields there may be little discussion of obvious techniques or combinations, and market demand, rather than scientific literature, may often drive design trends. Granting patent protection to advances that would occur in the ordinary course without real innovation retards progress and may, for patents combining previously known elements, deprive prior inventions of their value or utility. Since the TSM test was devised, the Federal Circuit doubtless has applied it in accord with these principles in many cases. There is no necessary inconsistency between the test and the *Graham* analysis. But a court errs where, as here, it transforms general principle into a rigid rule limiting the obviousness inquiry. Pp. 14–15.

(c) The flaws in the Federal Circuit's analysis relate mostly to its narrow conception of the obviousness inquiry consequent in its application of the TSM test. The Circuit first erred in holding that courts and patent examiners should look only to the problem the patentee was trying to solve. Under the correct analysis, any need or problem known in the field and addressed by the patent can provide a reason for combining the elements in the manner claimed. Second, the appeals court erred in assuming that a person of ordinary skill in the art attempting to solve a problem will be led only to those prior art elements designed to solve the same problem. The court wrongly concluded that because Asano's primary purpose was solving the constant ratio problem, an inventor considering how to put a sensor on an adjustable pedal would have no reason to consider putting it on the Asano pedal. It is common sense that familiar items may have obvious uses beyond their primary purposes, and a person of ordinary skill often will be able to fit the teachings of multiple patents together like pieces of a puzzle. Regardless of Asano's primary purpose, it provided an obvious example of an adjustable pedal with a fixed pivot point, and the prior art was replete with patents indicating that such a point was an ideal mount for a sensor. Third, the

court erred in concluding that a patent claim cannot be proved obvious merely by showing that the combination of elements was obvious to try. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. Finally, the court drew the wrong conclusion from the risk of courts and patent examiners falling prey to hindsight bias. Rigid preventative rules that deny recourse to common sense are neither necessary under, nor consistent with, this Court's case law. Pp. 15–18.

2. Application of the foregoing standards demonstrates that claim 4 is obvious. Pp. 18–23.

(a) The Court rejects Teleflex's argument that the Asano pivot mechanism's design prevents its combination with a sensor in the manner claim 4 describes. This argument was not raised before the District Court, and it is unclear whether it was raised before the Federal Circuit. Given the significance of the District Court's finding that combining Asano with a pivot-mounted pedal position sensor fell within claim 4's scope, it is apparent that Teleflex would have made clearer challenges if it intended to preserve this claim. Its failure to clearly raise the argument, and the appeals court's silence on the issue, lead this Court to accept the District Court's conclusion. Pp. 18–20.

(b) The District Court correctly concluded that when Engelgau designed the claim 4 subject matter, it was obvious to a person of ordinary skill in the art to combine Asano with a pivot-mounted pedal position sensor. There then was a marketplace creating a strong incentive to convert mechanical pedals to electronic pedals, and the prior art taught a number of methods for doing so. The Federal Circuit considered the issue too narrowly by, in effect, asking whether a pedal designer writing on a blank slate would have chosen both Asano and a modular sensor similar to the ones used in the Chevrolet trucks and disclosed in the '068 patent. The proper question was whether a pedal designer of ordinary skill in the art, facing the wide range of needs created by developments in the field, would have seen an obvious benefit to upgrading Asano with a sensor. For such a designer starting with Asano, the question was where to attach the sensor. The '936 patent taught the utility of putting the sensor on the pedal device. Smith, in turn, explained not to put the sensor on the pedal footpad, but instead on the structure. And from Rixon's known wire-chafing problems, and Smith's teaching that the pedal assemblies must not precipitate any motion in the connecting wires,

Syllabus

the designer would know to place the sensor on a nonmoving part of the pedal structure. The most obvious such point is a pivot point. The designer, accordingly, would follow Smith in mounting the sensor there. Just as it was possible to begin with the objective to upgrade Asano to work with a computer-controlled throttle, so too was it possible to take an adjustable electronic pedal like Rixon and seek an improvement that would avoid the wire-chafing problem. Teleflex has not shown anything in the prior art that taught away from the use of Asano, nor any secondary factors to dislodge the determination that claim 4 is obvious. Pp. 20–23.

3. The Court disagrees with the Federal Circuit's holding that genuine issues of material fact precluded summary judgment. The ultimate judgment of obviousness is a legal determination. *Graham*, 383 U. S., at 17. Where, as here, the prior art's content, the patent claim's scope, and the level of ordinary skill in the art are not in material dispute and the claim's obviousness is apparent, summary judgment is appropriate. P. 23.

119 Fed. Appx. 282, reversed and remanded.

KENNEDY, J., delivered the opinion for a unanimous Court.

SUPREME COURT OF THE UNITED STATES

No. 04–1350

KSR INTERNATIONAL CO., PETITIONER *v.*
TELEFLEX INC. ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

[April 30, 2007]

JUSTICE KENNEDY delivered the opinion of the Court.

Teleflex Incorporated and its subsidiary Technology Holding Company—both referred to here as Teleflex—sued KSR International Company for patent infringement. The patent at issue, United States Patent No. 6,237,565 B1, is entitled "Adjustable Pedal Assembly With Electronic Throttle Control." Supplemental App. 1. The patentee is Steven J. Engelgau, and the patent is referred to as "the Engelgau patent." Teleflex holds the exclusive license to the patent.

Claim 4 of the Engelgau patent describes a mechanism for combining an electronic sensor with an adjustable automobile pedal so the pedal's position can be transmitted to a computer that controls the throttle in the vehicle's engine. When Teleflex accused KSR of infringing the Engelgau patent by adding an electronic sensor to one of KSR's previously designed pedals, KSR countered that claim 4 was invalid under the Patent Act, 35 U. S. C. §103, because its subject matter was obvious.

Section 103 forbids issuance of a patent when "the differences between the subject matter sought to be pat-

ented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."

In *Graham* v. *John Deere Co. of Kansas City*, 383 U. S. 1 (1966), the Court set out a framework for applying the statutory language of §103, language itself based on the logic of the earlier decision in *Hotchkiss* v. *Greenwood*, 11 How. 248 (1851), and its progeny. See 383 U. S., at 15–17. The analysis is objective:

> "Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." *Id.*, at 17–18.

While the sequence of these questions might be reordered in any particular case, the factors continue to define the inquiry that controls. If a court, or patent examiner, conducts this analysis and concludes the claimed subject matter was obvious, the claim is invalid under §103.

Seeking to resolve the question of obviousness with more uniformity and consistency, the Court of Appeals for the Federal Circuit has employed an approach referred to by the parties as the "teaching, suggestion, or motivation" test (TSM test), under which a patent claim is only proved obvious if "some motivation or suggestion to combine the prior art teachings" can be found in the prior art, the nature of the problem, or the knowledge of a person having ordinary skill in the art. See, *e.g.*, *Al-Site Corp.* v. *VSI*

Int'l, Inc., 174 F. 3d 1308, 1323–1324 (CA Fed. 1999). KSR challenges that test, or at least its application in this case. See 119 Fed. Appx. 282, 286–290 (CA Fed. 2005). Because the Court of Appeals addressed the question of obviousness in a manner contrary to §103 and our precedents, we granted certiorari, 547 U. S ___ (2006). We now reverse.

I

A

In car engines without computer-controlled throttles, the accelerator pedal interacts with the throttle via cable or other mechanical link. The pedal arm acts as a lever rotating around a pivot point. In a cable-actuated throttle control the rotation caused by pushing down the pedal pulls a cable, which in turn pulls open valves in the carburetor or fuel injection unit. The wider the valves open, the more fuel and air are released, causing combustion to increase and the car to accelerate. When the driver takes his foot off the pedal, the opposite occurs as the cable is released and the valves slide closed.

In the 1990's it became more common to install computers in cars to control engine operation. Computer-controlled throttles open and close valves in response to electronic signals, not through force transferred from the pedal by a mechanical link. Constant, delicate adjustments of air and fuel mixture are possible. The computer's rapid processing of factors beyond the pedal's position improves fuel efficiency and engine performance.

For a computer-controlled throttle to respond to a driver's operation of the car, the computer must know what is happening with the pedal. A cable or mechanical link does not suffice for this purpose; at some point, an electronic sensor is necessary to translate the mechanical operation into digital data the computer can understand.

Before discussing sensors further we turn to the me-

chanical design of the pedal itself. In the traditional design a pedal can be pushed down or released but cannot have its position in the footwell adjusted by sliding the pedal forward or back. As a result, a driver who wishes to be closer or farther from the pedal must either reposition himself in the driver's seat or move the seat in some way. In cars with deep footwells these are imperfect solutions for drivers of smaller stature. To solve the problem, inventors, beginning in the 1970's, designed pedals that could be adjusted to change their location in the footwell. Important for this case are two adjustable pedals disclosed in U. S. Patent Nos. 5,010,782 (filed July 28, 1989) (Asano) and 5,460,061 (filed Sept. 17, 1993) (Redding). The Asano patent reveals a support structure that houses the pedal so that even when the pedal location is adjusted relative to the driver, one of the pedal's pivot points stays fixed. The pedal is also designed so that the force necessary to push the pedal down is the same regardless of adjustments to its location. The Redding patent reveals a different, sliding mechanism where both the pedal and the pivot point are adjusted.

We return to sensors. Well before Engelgau applied for his challenged patent, some inventors had obtained patents involving electronic pedal sensors for computer-controlled throttles. These inventions, such as the device disclosed in U. S. Patent No. 5,241,936 (filed Sept. 9, 1991) ('936), taught that it was preferable to detect the pedal's position in the pedal assembly, not in the engine. The '936 patent disclosed a pedal with an electronic sensor on a pivot point in the pedal assembly. U. S. Patent No. 5,063,811 (filed July 9, 1990) (Smith) taught that to prevent the wires connecting the sensor to the computer from chafing and wearing out, and to avoid grime and damage from the driver's foot, the sensor should be put on a fixed part of the pedal assembly rather than in or on the pedal's footpad.

In addition to patents for pedals with integrated sensors inventors obtained patents for self-contained modular sensors. A modular sensor is designed independently of a given pedal so that it can be taken off the shelf and attached to mechanical pedals of various sorts, enabling the pedals to be used in automobiles with computer-controlled throttles. One such sensor was disclosed in U. S. Patent No. 5,385,068 (filed Dec. 18, 1992) ('068). In 1994, Chevrolet manufactured a line of trucks using modular sensors "attached to the pedal support bracket, adjacent to the pedal and engaged with the pivot shaft about which the pedal rotates in operation." 298 F. Supp. 2d 581, 589 (ED Mich. 2003).

The prior art contained patents involving the placement of sensors on adjustable pedals as well. For example, U. S. Patent No. 5,819,593 (filed Aug. 17, 1995) (Rixon) discloses an adjustable pedal assembly with an electronic sensor for detecting the pedal's position. In the Rixon pedal the sensor is located in the pedal footpad. The Rixon pedal was known to suffer from wire chafing when the pedal was depressed and released.

This short account of pedal and sensor technology leads to the instant case.

B

KSR, a Canadian company, manufactures and supplies auto parts, including pedal systems. Ford Motor Company hired KSR in 1998 to supply an adjustable pedal system for various lines of automobiles with cable-actuated throttle controls. KSR developed an adjustable mechanical pedal for Ford and obtained U. S. Patent No. 6,151,976 (filed July 16, 1999) ('976) for the design. In 2000, KSR was chosen by General Motors Corporation (GMC or GM) to supply adjustable pedal systems for Chevrolet and GMC light trucks that used engines with computer-controlled throttles. To make the '976 pedal compatible with the

trucks, KSR merely took that design and added a modular sensor.

Teleflex is a rival to KSR in the design and manufacture of adjustable pedals. As noted, it is the exclusive licensee of the Engelgau patent. Engelgau filed the patent application on August 22, 2000 as a continuation of a previous application for U. S. Patent No. 6,109,241, which was filed on January 26, 1999. He has sworn he invented the patent's subject matter on February 14, 1998. The Engelgau patent discloses an adjustable electronic pedal described in the specification as a "simplified vehicle control pedal assembly that is less expensive, and which uses fewer parts and is easier to package within the vehicle." Engelgau, col. 2, lines 2–5, Supplemental App. 6. Claim 4 of the patent, at issue here, describes:

> "A vehicle control pedal apparatus comprising:
>
> a support adapted to be mounted to a vehicle structure;
>
> an adjustable pedal assembly having a pedal arm moveable in for[e] and aft directions with respect to said support;
>
> a pivot for pivotally supporting said adjustable pedal assembly with respect to said support and defining a pivot axis; and
>
> an electronic control attached to said support for controlling a vehicle system;
>
> said apparatus characterized by said electronic control being responsive to said pivot for providing a signal that corresponds to pedal arm position as said pedal arm pivots about said pivot axis between rest and applied positions wherein the position of said pivot remains constant while said pedal arm moves in fore and aft directions with respect to said pivot." *Id.*, col.

6, lines 17–36, Supplemental App. 8 (diagram numbers omitted).

We agree with the District Court that the claim discloses "a position-adjustable pedal assembly with an electronic pedal position sensor attached to the support member of the pedal assembly. Attaching the sensor to the support member allows the sensor to remain in a fixed position while the driver adjusts the pedal." 298 F. Supp. 2d, at 586–587.

Before issuing the Engelgau patent the U. S. Patent and Trademark Office (PTO) rejected one of the patent claims that was similar to, but broader than, the present claim 4. The claim did not include the requirement that the sensor be placed on a fixed pivot point. The PTO concluded the claim was an obvious combination of the prior art disclosed in Redding and Smith, explaining:

> "'Since the prior ar[t] references are from the field of endeavor, the purpose disclosed . . . would have been recognized in the pertinent art of Redding. Therefore it would have been obvious . . . to provide the device of Redding with the . . . means attached to a support member as taught by Smith.'" *Id.*, at 595.

In other words Redding provided an example of an adjustable pedal and Smith explained how to mount a sensor on a pedal's support structure, and the rejected patent claim merely put these two teachings together.

Although the broader claim was rejected, claim 4 was later allowed because it included the limitation of a fixed pivot point, which distinguished the design from Redding's. *Ibid.* Engelgau had not included Asano among the prior art references, and Asano was not mentioned in the patent's prosecution. Thus, the PTO did not have before it an adjustable pedal with a fixed pivot point. The patent issued on May 29, 2001 and was assigned to Teleflex.

Upon learning of KSR's design for GM, Teleflex sent a

warning letter informing KSR that its proposal would violate the Engelgau patent. "'Teleflex believes that any supplier of a product that combines an adjustable pedal with an electronic throttle control necessarily employs technology covered by one or more'" of Teleflex's patents. *Id.*, at 585. KSR refused to enter a royalty arrangement with Teleflex; so Teleflex sued for infringement, asserting KSR's pedal infringed the Engelgau patent and two other patents. *Ibid.* Teleflex later abandoned its claims regarding the other patents and dedicated the patents to the public. The remaining contention was that KSR's pedal system for GM infringed claim 4 of the Engelgau patent. Teleflex has not argued that the other three claims of the patent are infringed by KSR's pedal, nor has Teleflex argued that the mechanical adjustable pedal designed by KSR for Ford infringed any of its patents.

C

The District Court granted summary judgment in KSR's favor. After reviewing the pertinent history of pedal design, the scope of the Engelgau patent, and the relevant prior art, the court considered the validity of the contested claim. By direction of 35 U. S. C. §282, an issued patent is presumed valid. The District Court applied *Graham*'s framework to determine whether under summary-judgment standards KSR had overcome the presumption and demonstrated that claim 4 was obvious in light of the prior art in existence when the claimed subject matter was invented. See §102(a).

The District Court determined, in light of the expert testimony and the parties' stipulations, that the level of ordinary skill in pedal design was "'an undergraduate degree in mechanical engineering (or an equivalent amount of industry experience) [and] familiarity with pedal control systems for vehicles.'" 298 F. Supp. 2d, at 590. The court then set forth the relevant prior art, in-

cluding the patents and pedal designs described above.

Following *Graham*'s direction, the court compared the teachings of the prior art to the claims of Engelgau. It found "little difference." 298 F. Supp. 2d, at 590. Asano taught everything contained in claim 4 except the use of a sensor to detect the pedal's position and transmit it to the computer controlling the throttle. That additional aspect was revealed in sources such as the '068 patent and the sensors used by Chevrolet.

Under the controlling cases from the Court of Appeals for the Federal Circuit, however, the District Court was not permitted to stop there. The court was required also to apply the TSM test. The District Court held KSR had satisfied the test. It reasoned (1) the state of the industry would lead inevitably to combinations of electronic sensors and adjustable pedals, (2) Rixon provided the basis for these developments, and (3) Smith taught a solution to the wire chafing problems in Rixon, namely locating the sensor on the fixed structure of the pedal. This could lead to the combination of Asano, or a pedal like it, with a pedal position sensor.

The conclusion that the Engelgau design was obvious was supported, in the District Court's view, by the PTO's rejection of the broader version of claim 4. Had Engelgau included Asano in his patent application, it reasoned, the PTO would have found claim 4 to be an obvious combination of Asano and Smith, as it had found the broader version an obvious combination of Redding and Smith. As a final matter, the District Court held that the secondary factor of Teleflex's commercial success with pedals based on Engelgau's design did not alter its conclusion. The District Court granted summary judgment for KSR.

With principal reliance on the TSM test, the Court of Appeals reversed. It ruled the District Court had not been strict enough in applying the test, having failed to make "'finding[s] as to the specific understanding or principle

within the knowledge of a skilled artisan that would have motivated one with no knowledge of [the] invention' . . . to attach an electronic control to the support bracket of the Asano assembly." 119 Fed. Appx., at 288 (brackets in original) (quoting *In re Kotzab*, 217 F. 3d 1365, 1371 (CA Fed. 2000)). The Court of Appeals held that the District Court was incorrect that the nature of the problem to be solved satisfied this requirement because unless the "prior art references address[ed] the precise problem that the patentee was trying to solve," the problem would not motivate an inventor to look at those references. 119 Fed. Appx., at 288.

Here, the Court of Appeals found, the Asano pedal was designed to solve the "'constant ratio problem'"—that is, to ensure that the force required to depress the pedal is the same no matter how the pedal is adjusted—whereas Engelgau sought to provide a simpler, smaller, cheaper adjustable electronic pedal. *Ibid.* As for Rixon, the court explained, that pedal suffered from the problem of wire chafing but was not designed to solve it. In the court's view Rixon did not teach anything helpful to Engelgau's purpose. Smith, in turn, did not relate to adjustable pedals and did not "necessarily go to the issue of motivation to attach the electronic control on the support bracket of the pedal assembly." *Ibid.* When the patents were interpreted in this way, the Court of Appeals held, they would not have led a person of ordinary skill to put a sensor on the sort of pedal described in Asano.

That it might have been obvious to try the combination of Asano and a sensor was likewise irrelevant, in the court's view, because "'"[o]bvious to try" has long been held not to constitute obviousness.'" *Id.*, at 289 (quoting *In re Deuel*, 51 F. 3d 1552, 1559 (CA Fed. 1995)).

The Court of Appeals also faulted the District Court's consideration of the PTO's rejection of the broader version of claim 4. The District Court's role, the Court of Appeals

explained, was not to speculate regarding what the PTO might have done had the Engelgau patent mentioned Asano. Rather, the court held, the District Court was obliged first to presume that the issued patent was valid and then to render its own independent judgment of obviousness based on a review of the prior art. The fact that the PTO had rejected the broader version of claim 4, the Court of Appeals said, had no place in that analysis.

The Court of Appeals further held that genuine issues of material fact precluded summary judgment. Teleflex had proffered statements from one expert that claim 4 "'was a simple, elegant, and novel combination of features,'" 119 Fed. Appx., at 290, compared to Rixon, and from another expert that claim 4 was nonobvious because, unlike in Rixon, the sensor was mounted on the support bracket rather than the pedal itself. This evidence, the court concluded, sufficed to require a trial.

II

A

We begin by rejecting the rigid approach of the Court of Appeals. Throughout this Court's engagement with the question of obviousness, our cases have set forth an expansive and flexible approach inconsistent with the way the Court of Appeals applied its TSM test here. To be sure, *Graham* recognized the need for "uniformity and definiteness." 383 U. S., at 18. Yet the principles laid down in *Graham* reaffirmed the "functional approach" of *Hotchkiss*, 11 How. 248. See 383 U. S., at 12. To this end, *Graham* set forth a broad inquiry and invited courts, where appropriate, to look at any secondary considerations that would prove instructive. *Id.*, at 17.

Neither the enactment of §103 nor the analysis in *Graham* disturbed this Court's earlier instructions concerning the need for caution in granting a patent based on the combination of elements found in the prior art. For over a

half century, the Court has held that a "patent for a combination which only unites old elements with no change in their respective functions . . . obviously withdraws what is already known into the field of its monopoly and diminishes the resources available to skillful men." *Great Atlantic & Pacific Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147, 152 (1950). This is a principal reason for declining to allow patents for what is obvious. The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. Three cases decided after *Graham* illustrate the application of this doctrine.

In *United States* v. *Adams*, 383 U. S. 39, 40 (1966), a companion case to *Graham*, the Court considered the obviousness of a "wet battery" that varied from prior designs in two ways: It contained water, rather than the acids conventionally employed in storage batteries; and its electrodes were magnesium and cuprous chloride, rather than zinc and silver chloride. The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result. 383 U. S., at 50–51. It nevertheless rejected the Government's claim that Adams's battery was obvious. The Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious. *Id.*, at 51–52. When Adams designed his battery, the prior art warned that risks were involved in using the types of electrodes he employed. The fact that the elements worked together in an unexpected and fruitful manner supported the conclusion that Adams's design was not obvious to those skilled in the art.

In *Anderson's-Black Rock, Inc.* v. *Pavement Salvage Co.*, 396 U. S. 57 (1969), the Court elaborated on this approach.

The subject matter of the patent before the Court was a device combining two pre-existing elements: a radiant-heat burner and a paving machine. The device, the Court concluded, did not create some new synergy: The radiant-heat burner functioned just as a burner was expected to function; and the paving machine did the same. The two in combination did no more than they would in separate, sequential operation. *Id.*, at 60–62. In those circumstances, "while the combination of old elements performed a useful function, it added nothing to the nature and quality of the radiant-heat burner already patented," and the patent failed under §103. *Id.*, at 62 (footnote omitted).

Finally, in *Sakraida* v. *AG Pro, Inc.*, 425 U. S. 273 (1976), the Court derived from the precedents the conclusion that when a patent "simply arranges old elements with each performing the same function it had been known to perform" and yields no more than one would expect from such an arrangement, the combination is obvious. *Id.*, at 282.

The principles underlying these cases are instructive when the question is whether a patent claiming the combination of elements of prior art is obvious. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, §103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Sakraida* and *Anderson's-Black Rock* are illustrative—a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.

Following these principles may be more difficult in other

cases than it is here because the claimed subject matter may involve more than the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement. Often, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit. See *In re Kahn*, 441 F. 3d 977, 988 (CA Fed. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness"). As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.

B

When it first established the requirement of demonstrating a teaching, suggestion, or motivation to combine known elements in order to show that the combination is obvious, the Court of Customs and Patent Appeals captured a helpful insight. See *Application of Bergel*, 292 F. 2d 955, 956–957 (1961). As is clear from cases such as *Adams*, a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established

functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.

Helpful insights, however, need not become rigid and mandatory formulas; and when it is so applied, the TSM test is incompatible with our precedents. The obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents. The diversity of inventive pursuits and of modern technology counsels against limiting the analysis in this way. In many fields it may be that there is little discussion of obvious techniques or combinations, and it often may be the case that market demand, rather than scientific literature, will drive design trends. Granting patent protection to advances that would occur in the ordinary course without real innovation retards progress and may, in the case of patents combining previously known elements, deprive prior inventions of their value or utility.

In the years since the Court of Customs and Patent Appeals set forth the essence of the TSM test, the Court of Appeals no doubt has applied the test in accord with these principles in many cases. There is no necessary inconsistency between the idea underlying the TSM test and the *Graham* analysis. But when a court transforms the general principle into a rigid rule that limits the obviousness inquiry, as the Court of Appeals did here, it errs.

C

The flaws in the analysis of the Court of Appeals relate

for the most part to the court's narrow conception of the obviousness inquiry reflected in its application of the TSM test. In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. What matters is the objective reach of the claim. If the claim extends to what is obvious, it is invalid under §103. One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims.

The first error of the Court of Appeals in this case was to foreclose this reasoning by holding that courts and patent examiners should look only to the problem the patentee was trying to solve. 119 Fed. Appx., at 288. The Court of Appeals failed to recognize that the problem motivating the patentee may be only one of many addressed by the patent's subject matter. The question is not whether the combination was obvious to the patentee but whether the combination was obvious to a person with ordinary skill in the art. Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

The second error of the Court of Appeals lay in its assumption that a person of ordinary skill attempting to solve a problem will be led only to those elements of prior art designed to solve the same problem. *Ibid.* The primary purpose of Asano was solving the constant ratio problem; so, the court concluded, an inventor considering how to put a sensor on an adjustable pedal would have no reason to consider putting it on the Asano pedal. *Ibid.* Common sense teaches, however, that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a

puzzle. Regardless of Asano's primary purpose, the design provided an obvious example of an adjustable pedal with a fixed pivot point; and the prior art was replete with patents indicating that a fixed pivot point was an ideal mount for a sensor. The idea that a designer hoping to make an adjustable electronic pedal would ignore Asano because Asano was designed to solve the constant ratio problem makes little sense. A person of ordinary skill is also a person of ordinary creativity, not an automaton.

The same constricted analysis led the Court of Appeals to conclude, in error, that a patent claim cannot be proved obvious merely by showing that the combination of elements was "obvious to try." *Id.*, at 289 (internal quotation marks omitted). When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under §103.

The Court of Appeals, finally, drew the wrong conclusion from the risk of courts and patent examiners falling prey to hindsight bias. A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning. See *Graham*, 383 U. S., at 36 (warning against a "temptation to read into the prior art the teachings of the invention in issue" and instructing courts to "'guard against slipping into the use of hindsight'" (quoting *Monroe Auto Equipment Co.* v. *Heckethorn Mfg. & Supply Co.*, 332 F. 2d 406, 412 (CA6 1964))). Rigid preventative rules that deny factfinders recourse to common sense, however, are neither necessary under our case law nor consistent with it.

We note the Court of Appeals has since elaborated a

broader conception of the TSM test than was applied in the instant matter. See, *e.g.*, *DyStar Textilfarben GmbH & Co. Deutschland KG* v. *C. H. Patrick Co.*, 464 F. 3d 1356, 1367 (2006) ("Our suggestion test is in actuality quite flexible and not only permits, but *requires*, consideration of common knowledge and common sense"); *Alza Corp.* v. *Mylan Labs., Inc.*, 464 F. 3d 1286, 1291 (2006) ("There is flexibility in our obviousness jurisprudence because a motivation may be found *implicitly* in the prior art. We do not have a rigid test that requires an actual teaching to combine . . ."). Those decisions, of course, are not now before us and do not correct the errors of law made by the Court of Appeals in this case. The extent to which they may describe an analysis more consistent with our earlier precedents and our decision here is a matter for the Court of Appeals to consider in its future cases. What we hold is that the fundamental misunderstandings identified above led the Court of Appeals in this case to apply a test inconsistent with our patent law decisions.

III

When we apply the standards we have explained to the instant facts, claim 4 must be found obvious. We agree with and adopt the District Court's recitation of the relevant prior art and its determination of the level of ordinary skill in the field. As did the District Court, we see little difference between the teachings of Asano and Smith and the adjustable electronic pedal disclosed in claim 4 of the Engelgau patent. A person having ordinary skill in the art could have combined Asano with a pedal position sensor in a fashion encompassed by claim 4, and would have seen the benefits of doing so.

A

Teleflex argues in passing that the Asano pedal cannot be combined with a sensor in the manner described by

claim 4 because of the design of Asano's pivot mechanisms. See Brief for Respondents 48–49, and n. 17. Therefore, Teleflex reasons, even if adding a sensor to Asano was obvious, that does not establish that claim 4 encompasses obvious subject matter. This argument was not, however, raised before the District Court. There Teleflex was content to assert only that the problem motivating the invention claimed by the Engelgau patent would not lead to the solution of combining of Asano with a sensor. See Teleflex's Response to KSR's Motion for Summary Judgment of Invalidity in No. 02–74586 (ED Mich.), pp. 18–20, App. 144a–146a. It is also unclear whether the current argument was raised before the Court of Appeals, where Teleflex advanced the nonspecific, conclusory contention that combining Asano with a sensor would not satisfy the limitations of claim 4. See Brief for Plaintiffs-Appellants in No. 04–1152 (CA Fed.), pp. 42–44. Teleflex's own expert declarations, moreover, do not support the point Teleflex now raises. See Declaration of Clark J. Radcliffe, Ph.D., Supplemental App. 204–207; Declaration of Timothy L. Andresen, *id.*, at 208–210. The only statement in either declaration that might bear on the argument is found in the Radcliffe declaration:

> "Asano . . . and Rixon . . . are complex mechanical linkage-based devices that are expensive to produce and assemble and difficult to package. It is exactly these difficulties with prior art designs that [Engelgau] resolves. The use of an adjustable pedal with a single pivot reflecting pedal position combined with an electronic control mounted between the support and the adjustment assembly at that pivot was a simple, elegant, and novel combination of features in the Engelgau '565 patent." *Id.*, at 206, ¶16.

Read in the context of the declaration as a whole this is best interpreted to mean that Asano could not be used to

solve "[t]he problem addressed by Engelgau '565[:] to provide a less expensive, more quickly assembled, and smaller package adjustable pedal assembly with electronic control." *Id.*, at 205, ¶10.

The District Court found that combining Asano with a pivot-mounted pedal position sensor fell within the scope of claim 4. 298 F. Supp. 2d, at 592–593. Given the sigificance of that finding to the District Court's judgment, it is apparent that Teleflex would have made clearer challenges to it if it intended to preserve this claim. In light of Teleflex's failure to raise the argument in a clear fashion, and the silence of the Court of Appeals on the issue, we take the District Court's conclusion on the point to be correct.

B

The District Court was correct to conclude that, as of the time Engelgau designed the subject matter in claim 4, it was obvious to a person of ordinary skill to combine Asano with a pivot-mounted pedal position sensor. There then existed a marketplace that created a strong incentive to convert mechanical pedals to electronic pedals, and the prior art taught a number of methods for achieving this advance. The Court of Appeals considered the issue too narrowly by, in effect, asking whether a pedal designer writing on a blank slate would have chosen both Asano and a modular sensor similar to the ones used in the Chevrolet truckline and disclosed in the '068 patent. The District Court employed this narrow inquiry as well, though it reached the correct result nevertheless. The proper question to have asked was whether a pedal designer of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to upgrading Asano with a sensor.

In automotive design, as in many other fields, the interaction of multiple components means that changing one

component often requires the others to be modified as well. Technological developments made it clear that engines using computer-controlled throttles would become standard. As a result, designers might have decided to design new pedals from scratch; but they also would have had reason to make pre-existing pedals work with the new engines. Indeed, upgrading its own pre-existing model led KSR to design the pedal now accused of infringing the Engelgau patent.

For a designer starting with Asano, the question was where to attach the sensor. The consequent legal question, then, is whether a pedal designer of ordinary skill starting with Asano would have found it obvious to put the sensor on a fixed pivot point. The prior art discussed above leads us to the conclusion that attaching the sensor where both KSR and Engelgau put it would have been obvious to a person of ordinary skill.

The '936 patent taught the utility of putting the sensor on the pedal device, not in the engine. Smith, in turn, explained to put the sensor not on the pedal's footpad but instead on its support structure. And from the known wire-chafing problems of Rixon, and Smith's teaching that "the pedal assemblies must not precipitate any motion in the connecting wires," Smith, col. 1, lines 35–37, Supplemental App. 274, the designer would know to place the sensor on a nonmoving part of the pedal structure. The most obvious nonmoving point on the structure from which a sensor can easily detect the pedal's position is a pivot point. The designer, accordingly, would follow Smith in mounting the sensor on a pivot, thereby designing an adjustable electronic pedal covered by claim 4.

Just as it was possible to begin with the objective to upgrade Asano to work with a computer-controlled throttle, so too was it possible to take an adjustable electronic pedal like Rixon and seek an improvement that would avoid the wire-chafing problem. Following similar steps to

those just explained, a designer would learn from Smith to avoid sensor movement and would come, thereby, to Asano because Asano disclosed an adjustable pedal with a fixed pivot.

Teleflex indirectly argues that the prior art taught away from attaching a sensor to Asano because Asano in its view is bulky, complex, and expensive. The only evidence Teleflex marshals in support of this argument, however, is the Radcliffe declaration, which merely indicates that Asano would not have solved Engelgau's goal of making a small, simple, and inexpensive pedal. What the declaration does not indicate is that Asano was somehow so flawed that there was no reason to upgrade it, or pedals like it, to be compatible with modern engines. Indeed, Teleflex's own declarations refute this conclusion. Dr. Radcliffe states that Rixon suffered from the same bulk and complexity as did Asano. See *id.*, at 206. Teleflex's other expert, however, explained that Rixon was itself designed by adding a sensor to a pre-existing mechanical pedal. See *id.*, at 209. If Rixon's base pedal was not too flawed to upgrade, then Dr. Radcliffe's declaration does not show Asano was either. Teleflex may have made a plausible argument that Asano is inefficient as compared to Engelgau's preferred embodiment, but to judge Asano against Engelgau would be to engage in the very hindsight bias Teleflex rightly urges must be avoided. Accordingly, Teleflex has not shown anything in the prior art that taught away from the use of Asano.

Like the District Court, finally, we conclude Teleflex has shown no secondary factors to dislodge the determination that claim 4 is obvious. Proper application of *Graham* and our other precedents to these facts therefore leads to the conclusion that claim 4 encompassed obvious subject matter. As a result, the claim fails to meet the requirement of §103.

We need not reach the question whether the failure to

disclose Asano during the prosecution of Engelgau voids the presumption of validity given to issued patents, for claim 4 is obvious despite the presumption. We nevertheless think it appropriate to note that the rationale underlying the presumption—that the PTO, in its expertise, has approved the claim—seems much diminished here.

IV

A separate ground the Court of Appeals gave for reversing the order for summary judgment was the existence of a dispute over an issue of material fact. We disagree with the Court of Appeals on this point as well. To the extent the court understood the *Graham* approach to exclude the possibility of summary judgment when an expert provides a conclusory affidavit addressing the question of obviousness, it misunderstood the role expert testimony plays in the analysis. In considering summary judgment on that question the district court can and should take into account expert testimony, which may resolve or keep open certain questions of fact. That is not the end of the issue, however. The ultimate judgment of obviousness is a legal determination. *Graham*, 383 U. S., at 17. Where, as here, the content of the prior art, the scope of the patent claim, and the level of ordinary skill in the art are not in material dispute, and the obviousness of the claim is apparent in light of these factors, summary judgment is appropriate. Nothing in the declarations proffered by Teleflex prevented the District Court from reaching the careful conclusions underlying its order for summary judgment in this case.

* * *

We build and create by bringing to the tangible and palpable reality around us new works based on instinct, simple logic, ordinary inferences, extraordinary ideas, and sometimes even genius. These advances, once part of our

shared knowledge, define a new threshold from which innovation starts once more. And as progress beginning from higher levels of achievement is expected in the normal course, the results of ordinary innovation are not the subject of exclusive rights under the patent laws. Were it otherwise patents might stifle, rather than promote, the progress of useful arts. See U. S. Const., Art. I, §8, cl. 8. These premises led to the bar on patents claiming obvious subject matter established in *Hotchkiss* and codified in §103. Application of the bar must not be confined within a test or formulation too constrained to serve its purpose.

KSR provided convincing evidence that mounting a modular sensor on a fixed pivot point of the Asano pedal was a design step well within the grasp of a person of ordinary skill in the relevant art. Its arguments, and the record, demonstrate that claim 4 of the Engelgau patent is obvious. In rejecting the District Court's rulings, the Court of Appeals analyzed the issue in a narrow, rigid manner inconsistent with §103 and our precedents. The judgment of the Court of Appeals is reversed, and the case remanded for further proceedings consistent with this opinion.

It is so ordered.

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix E

Graham v. John Deere 383 U.S. 1 (1966)

U.S. Supreme Court

GRAHAM v. JOHN DEERE CO., 383 U.S. 1 (1966)

383 U.S. 1

GRAHAM ET AL. v. JOHN DEERE CO. OF KANSAS CITY ET AL.
CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE EIGHTH CIRCUIT.
No. 11.
Argued October 14, 1965.
Decided February 21, 1966.*

[Footnote *] Together with No. 37, Calmar, Inc. v. Cook Chemical Co., and No. 43, Colgate-Palmolive Co. v. Cook Chemical Co., also on certiorari to the same court.

In No. 11 petitioners sued for infringement of a patent, consisting of a combination of old mechanical elements, for a device designed to absorb shock from plow shanks in rocky soil to prevent damage to the plow. In 1955 the Fifth Circuit held the patent valid, ruling that a combination is patentable when it produces an "old result in a cheaper and otherwise more advantageous way." Here the Eighth Circuit held that since there was no new result in the combination the patent was invalid. Petitioners in Nos. 37 and 43 filed actions for declaratory judgments declaring invalid respondent's patent relating to a plastic finger sprayer with a "hold-down" cap used as a built-in dispenser for containers with liquids, principally insecticides. By cross-action respondent claimed infringement. The District Court and the Court of Appeals sustained the patent. Held: The patents do not meet the test of the "nonobvious" nature of the "subject matter sought to be patented" to a person having ordinary skill in the pertinent art, set forth in 103 of the Patent Act of 1952, and are therefore invalid. Pp. 3-37.

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(a) In carrying out the constitutional command of Art. I, 8, that a patent system "promote the Progress of . . . useful Arts," Congress established the two statutory requirements of novelty and utility in the Patent Act of 1793. Pp. 3, 6, 12.
(b) This Court in Hotchkiss v. Greenwood, 11 How. 248 (1851), additionally conditioned the issuance of a patent upon the evidence of more ingenuity and skill than that possessed by an ordinary mechanic acquainted with the business. P. 11.
(c) In 103 of the 1952 Patent Act Congress added the statutory nonobvious subject matter requirement, originally expounded in Hotchkiss, which merely codified judicial precedents requiring a comparison of the subject matter sought to be patented and the prior art, tying patentable inventions to advances in the art. Although 103 places emphasis upon inquiries

into obviousness, rather than into "invention," the general level of innovation necessary to sustain patentability remains unchanged under the 1952 Act. Pp. 14-17.

(d) This section permits a more practical test of patentability. The determination of "nonobviousness" is made after establishing the scope and content of prior art, the differences between the prior art and the claims at issue, and the level of ordinary skill in the pertinent art. P. 17.

(e) With respect to each patent involved here the differences between the claims in issue and the pertinent prior art would have been obvious to a person reasonably skilled in that art. Pp. 25-26, 37.

333 F.2d 529, affirmed; 336 F.2d 110, reversed and remanded.

Orville O. Gold argued the cause for petitioners in No. 11. With him on the brief was Claude A. Fishburn. Dennis G. Lyons argued the cause for petitioners in Nos. 37 and 43. With him on the briefs for petitioner in No. 37 were Victor H. Kramer and Francis G. Cole. On the brief for petitioner in No. 43 were George H. Mortimer and Howard A. Crawford.

S. Tom Morris argued the cause for respondents in No. 11. With him on the brief were W. W. Gibson and Thomas E. Scofield. Gordon D. Schmidt argued the cause for respondent in Nos. 37 and 43. With him on

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the brief were Carl E. Enggas, Hugh B. Cox and Charles A. Miller.

Briefs of amici curiae in No. 11 were filed by Roger Robb for the American Bar Association; by Stanton T. Lawrence, Jr., for the New York Patent Law Association; by George E. Frost for the Illinois State Bar Association; by J. Vincent Martin, Alfred H. Evans and Russell E. Schlorff for the State Bar of Texas; and by Robert W. Hamilton for the School of Law of the University of Texas.

MR. JUSTICE CLARK delivered the opinion of the Court.

After a lapse of 15 years, the Court again focuses its attention on the patentability of inventions under the standard of Art. I, 8, cl. 8, of the Constitution and under the conditions prescribed by the laws of the United States. Since our last expression on patent validity, A. & P. Tea Co. v. Supermarket Corp., 340 U.S. 147 (1950), the Congress has for the first time expressly added a third statutory dimension to the two requirements of novelty and utility that had been the sole statutory test since the Patent Act of 1793. This is the test of obviousness, i. e., whether "the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made." 103 of the Patent Act of 1952, 35 U.S.C. 103 (1964 ed.).

The questions, involved in each of the companion cases before us, are what effect the 1952 Act had upon traditional statutory and judicial tests of patentability and what definitive tests are now required. We have concluded that the 1952 Act was intended to codify judicial precedents embracing the principle long ago

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announced by this Court in Hotchkiss v. Greenwood, 11 How. 248 (1851), and that, while the clear language of 103 places emphasis on an inquiry into obviousness, the general level of innovation necessary to sustain patentability remains the same.

I.

The Cases.

(a). No. 11, Graham v. John Deere Co., an infringement suit by petitioners, presents a conflict between two Circuits over the validity of a single patent on a "Clamp for vibrating Shank Plows." The invention, a combination of old mechanical elements, involves a device designed to absorb shock from plow shanks as they plow through rocky soil and thus to prevent damage to the plow. In 1955, the Fifth Circuit had held the patent valid under its rule that when a combination produces an "old result in a cheaper and otherwise more advantageous way," it is patentable. Jeoffroy Mfg., Inc. v. Graham, 219 F.2d 511, cert. denied, 350 U.S. 826. In 1964, the Eighth Circuit held, in the case at bar, that there was no new result in the patented combination and that the patent was, therefore, not valid. 333 F.2d 529, reversing 216 F. Supp. 272. We granted certiorari, 379 U.S. 956. Although we have determined that neither Circuit applied the correct test, we conclude that the patent is invalid under 103 and, therefore, we affirm the judgment of the Eighth Circuit.

(b). No. 37, Calmar, Inc. v. Cook Chemical Co., and No. 43, Colgate-Palmolive Co. v. Cook Chemical Co., both from the Eighth Circuit, were separate declaratory judgment actions, but were filed contemporaneously. Petitioner in Calmar is the manufacturer of a finger-operated sprayer with a "hold-down" cap of the type commonly seen on grocers' shelves inserted in bottles of insecticides and other liquids prior to shipment. Petitioner in Colgate-Palmolive is a purchaser of the sprayers

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and uses them in the distribution of its products. Each action sought a declaration of invalidity and noninfringement of a patent on similar sprayers issued to Cook Chemical as assignee of Baxter I. Scoggin, Jr., the inventor. By cross-action, Cook Chemical claimed infringement. The actions were consolidated for trial and the patent was sustained by the District Court. 220 F. Supp. 414. The Court of Appeals affirmed, 336 F.2d 110, and we granted certiorari, 380 U.S. 949. We reverse.

Manifestly, the validity of each of these patents turns on the facts. The basic problems, however, are the same in each case and require initially a discussion of the constitutional and statutory provisions covering the patentability of the inventions.

II.

At the outset it must be remembered that the federal patent power stems from a specific constitutional provision which authorizes the Congress "To promote the Progress of . . . useful Arts, by securing for limited Times to . . . Inventors the exclusive Right to their . . . Discoveries." Art. I, 8, cl. 8.[Footnote 1] The clause is both a grant of power and a limitation. This qualified authority, unlike the power often exercised in the sixteenth and seventeenth centuries by the English Crown, is limited to the promotion of advances in the "useful arts." It was written against the backdrop of the practices - eventually curtailed by the Statute of Monopolies - of the Crown in granting monopolies to court favorites in goods or businesses which had long before been enjoyed by the public. See Meinhardt, Inventions, Patents and Monopoly, pp. 30-35 (London, 1946). The Congress in the

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exercise of the patent power may not overreach the restraints imposed by the stated constitutional purpose. Nor may it enlarge the patent monopoly without regard to the innovation, advancement or social benefit gained thereby. Moreover, Congress may not authorize the issuance of patents whose effects are to remove existent knowledge from the public domain, or to restrict free access to materials already available. Innovation, advancement, and things which add to the sum of useful knowledge are inherent requisites in a patent system which by constitutional command must "promote the Progress of . . . useful Arts." This is the standard expressed in the Constitution and it may not be ignored. And it is in this light that patent validity "requires reference to a standard written into the Constitution." A. & P. Tea Co. v. Supermarket Corp., supra, at 154 (concurring opinion).

Within the limits of the constitutional grant, the Congress may, of course, implement the stated purpose of the Framers by selecting the policy which in its judgment best effectuates the constitutional aim. This is but a corollary to the grant to Congress of any Article I power. Gibbons v. Ogden, 9 Wheat. 1. Within the scope established by the Constitution, Congress may set out conditions and tests for patentability. McClurg v. Kingsland, 1 How. 202, 206. It is the duty of the Commissioner of Patents and of the courts in the administration of the patent system to give effect to the constitutional standard by appropriate application, in each case, of the statutory scheme of the Congress.

Congress quickly responded to the bidding of the Constitution by enacting the Patent Act of 1790 during the second session of the First Congress. It created an agency in the Department of State headed by the Secretary of State, the Secretary of the Department of War

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and the Attorney General, any two of whom could issue a patent for a period not exceeding 14 years to any petitioner that "hath . . . invented or discovered any useful art, manufacture, . . . or device, or any improvement therein not before known or used" if the board found that "the invention or discovery [was] sufficiently useful and important . . . ." 1 Stat. 110. This group, whose members administered the patent system along with their other public duties, was known by its own designation as "Commissioners for the Promotion of Useful Arts."

Thomas Jefferson, who as Secretary of State was a member of the group, was its moving spirit and might well be called the "first administrator of our patent system." See Federico, Operation of the Patent Act of 1790, 18 J. Pat. Off. Soc. 237, 238 (1936). He was not only an administrator of the patent system under the 1790 Act, but was also the author of the 1793 Patent Act. In addition, Jefferson was himself an inventor of great note. His unpatented improvements on plows, to mention but one line of his inventions, won acclaim and recognition on both sides of the Atlantic. Because of his active interest and influence in the early development of the patent system, Jefferson's views on the general nature of the limited patent monopoly under the Constitution, as well as his conclusions as to conditions for patentability under the statutory scheme, are worthy of note.

Jefferson, like other Americans, had an instinctive aversion to monopolies. It was a monopoly on tea that sparked the Revolution and Jefferson certainly did not favor an equivalent form of monopoly under the new government. His abhorrence of monopoly extended initially to patents as well. From France, he wrote to Madison (July 1788) urging a Bill of Rights provision restricting monopoly, and as against the argument that

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limited monopoly might serve to incite "ingenuity," he argued forcefully that "the benefit even of limited monopolies is too doubtful to be opposed to that of their general suppression," V Writings of Thomas Jefferson, at 47 (Ford ed., 1895).

His views ripened, however, and in another letter to Madison (Aug. 1789) after the drafting of the Bill of Rights, Jefferson stated that he would have been pleased by an express provision in this form:

> "Art. 9. Monopolies may be allowed to persons for their own productions in literature & their own inventions in the arts, for a term not exceeding - years but for no longer term & no other purpose." Id., at 113.

And he later wrote:

> "Certainly an inventor ought to be allowed a right to the benefit of his invention for some certain time. . . . Nobody wishes more than I do that ingenuity should receive a liberal encouragement." Letter to Oliver Evans (May 1807), V Writings of Thomas Jefferson, at 75-76 (Washington ed.).

Jefferson's philosophy on the nature and purpose of the patent monopoly is expressed in a letter to Isaac McPherson (Aug. 1813), a portion of which we set out in the margin.[Footnote 2] He rejected a natural-rights theory in

intellectual property rights and clearly recognized the social and economic rationale of the patent system. The patent monopoly was not designed to secure to the inventor his natural right in his discoveries. Rather, it was a reward, an inducement, to bring forth new knowledge. The grant of an exclusive right to an invention was the creation of society - at odds with the inherent free nature of disclosed ideas - and was not to be freely given. Only inventions and discoveries which furthered human knowledge, and were new and useful, justified the special inducement of a limited private monopoly. Jefferson did not believe in granting patents for small details, obvious improvements, or frivolous devices. His writings evidence his insistence upon a high level of patentability.

As a member of the patent board for several years, Jefferson saw clearly the difficulty in "drawing a line between the things which are worth to the public the embarrassment of an exclusive patent, and those which are not." The board on which he served sought to draw such a line and formulated several rules which are preserved in

Jefferson's correspondence.[Footnote 3] Despite the board's efforts, Jefferson saw "with what slow progress a system of general rules could be matured." Because of the "abundance" of cases and the fact that the investigations occupied "more time of the members of the board than they could spare from higher duties, the whole was turned over to the judiciary, to be matured into a system, under which every one might know when his actions were safe and lawful." Letter to McPherson, supra, at 181, 182. Apparently Congress agreed with Jefferson and the board that the courts should develop additional conditions for patentability. Although the Patent Act was amended, revised or codified some 50 times between 1790 and 1950, Congress steered clear of a statutory set of requirements other than the bare novelty and utility tests reformulated in Jefferson's draft of the 1793 Patent Act.

III.

The difficulty of formulating conditions for patentability was heightened by the generality of the constitutional grant and the statutes implementing it, together with the underlying policy of the patent system that "the things which are worth to the public the embarrassment

of an exclusive patent," as Jefferson put it, must outweigh the restrictive effect of the limited patent monopoly. The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent.

This Court formulated a general condition of patentability in 1851 in Hotchkiss v. Greenwood, 11 How. 248. The patent involved a mere substitution of materials - porcelain or clay for wood or metal in doorknobs - and the Court condemned it, holding:[Footnote 4]

> "[U]nless more ingenuity and skill . . . were required . . . than were possessed by an ordinary mechanic acquainted with the business, there was an absence of that degree of skill and ingenuity which constitute essential elements of every invention. In other words, the improvement is the work of the skilful mechanic, not that of the inventor." At p. 267.

Hotchkiss, by positing the condition that a patentable invention evidence more ingenuity and skill than that possessed by an ordinary mechanic acquainted with the business, merely distinguished between new and useful innovations that were capable of sustaining a patent and those that were not. The Hotchkiss test laid the cornerstone of the judicial evolution suggested by Jefferson and left to the courts by Congress. The language in the case, and in those which followed, gave birth to "invention" as a word of legal art signifying patentable inventions. Yet, as this Court has observed, "[t]he truth is the word [`invention'] cannot be defined in such manner as to afford any substantial aid in determining whether a particular device involves an exercise of the inventive faculty

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or not." McClain v. Ortmayer, 141 U.S. 419, 427 (1891); A. & P. Tea Co. v. Supermarket Corp., supra, at 151. Its use as a label brought about a large variety of opinions as to its meaning both in the Patent Office, in the courts, and at the bar. The Hotchkiss formulation, however, lies not in any label, but in its functional approach to questions of patentability. In practice, Hotchkiss has required a comparison between the subject matter of the patent, or patent application, and the background skill of the calling. It has been from this comparison that patentability was in each case determined.

IV.

The 1952 Patent Act.

The Act sets out the conditions of patentability in three sections. An analysis of the structure of these three sections indicates that patentability is dependent upon three explicit conditions: novelty and utility as articulated and defined in 101 and 102, and nonobviousness, the new statutory formulation, as set out in 103. The first two sections, which trace closely the 1874 codification, express the "new and useful" tests which have always existed in the statutory scheme and, for our purposes here, need no clarification.[Footnote 5] The pivotal

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section around which the present controversy centers is 103. It provides:

> " 103. Conditions for patentability; non-obvious subject matter

"A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

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The section is cast in relatively unambiguous terms. Patentability is to depend, in addition to novelty and utility, upon the "non-obvious" nature of the "subject matter sought to be patented" to a person having ordinary skill in the pertinent art.

The first sentence of this section is strongly reminiscent of the language in Hotchkiss. Both formulations place emphasis on the pertinent art existing at the time the invention was made and both are implicitly tied to advances in that art. The major distinction is that Congress has emphasized "nonobviousness" as the operative test of the section, rather than the less definite "invention" language of Hotchkiss that Congress thought had led to "a large variety" of expressions in decisions and writings. In the title itself the Congress used the phrase "Conditions for patentability; non-obvious subject matter" (italics added), thus focusing upon "nonobviousness" rather than "invention."[Footnote 6] The Senate and House Reports, S. Rep. No. 1979, 82d Cong., 2d Sess. (1952); H. R. Rep. No. 1923, 82d Cong., 2d Sess. (1952), reflect this emphasis in these terms:

"Section 103, for the first time in our statute, provides a condition which exists in the law and has existed for more than 100 years, but only by reason of decisions of the courts. An invention which has been made, and which is new in the sense that the same thing has not been made before, may still not be patentable if the difference between the new thing and what was known before is not considered sufficiently great to warrant a patent. That has been expressed in a large variety of ways in decisions of

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the courts and in writings. Section 103 states this requirement in the title. It refers to the difference between the subject matter sought to be patented and the prior art, meaning what was known before as described in section 102. If this difference is such that the subject matter as a whole would have been obvious at the time to a person skilled in the art, then the subject matter cannot be patented.

"That provision paraphrases language which has often been used in decisions of the courts, and the section is added to the statute for uniformity and definiteness. This section should have a stabilizing effect and minimize great departures which have appeared in some cases." H. R. Rep., supra, at 7; S. Rep., supra, at 6.

It is undisputed that this section was, for the first time, a statutory expression of an additional requirement for patentability, originally expressed in Hotchkiss. It also seems apparent that Congress intended by the last sentence of 103 to abolish the test it believed this Court announced in the controversial phrase "flash of creative genius," used in Cuno Corp. v. Automatic Devices Corp., 314 U.S. 84 (1941).[Footnote 7]

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It is contended, however, by some of the parties and by several of the amici that the first sentence of 103 was intended to sweep away judicial precedents and to lower the level of patentability. Others contend that the Congress intended to codify the essential purpose reflected in existing judicial precedents - the rejection of insignificant variations and innovations of a commonplace sort - and also to focus inquiries under 103 upon nonobviousness, rather than upon "invention," as a means of achieving more stability and predictability in determining patentability and validity.

The Reviser's Note to this section,[Footnote 8] with apparent reference to Hotchkiss, recognizes that judicial requirements as to "lack of patentable novelty [have] been followed since at least as early as 1850." The note indicates that the section was inserted because it "may have some stabilizing effect, and also to serve as a basis for the addition at a later time of some criteria which may be worked out." To this same effect are the reports of both Houses, supra, which state that the first sentence

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of the section "paraphrases language which has often been used in decisions of the courts, and the section is added to the statute for uniformity and definiteness."

We believe that this legislative history, as well as other sources,[Footnote 9] shows that the revision was not intended by Congress to change the general level of patentable invention. We conclude that the section was intended merely as a codification of judicial precedents embracing the Hotchkiss condition, with congressional directions that inquiries into the obviousness of the subject matter sought to be patented are a prerequisite to patentability.

V.

Approached in this light, the 103 additional condition, when followed realistically, will permit a more practical test of patentability. The emphasis on nonobviousness is one of inquiry, not quality, and, as such, comports with the constitutional strictures.

While the ultimate question of patent validity is one of law, A. & P. Tea Co. v. Supermarket Corp., supra, at 155, the 103 condition, which is but one of three conditions, each of which must be satisfied, lends itself to several basic factual inquiries. Under 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the

level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances

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surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. See Note, Subtests of "Nonobviousness": A Nontechnical Approach to Patent Validity, 112 U. Pa. L. Rev. 1169 (1964).

This is not to say, however, that there will not be difficulties in applying the nonobviousness test. What is obvious is not a question upon which there is likely to be uniformity of thought in every given factual context. The difficulties, however, are comparable to those encountered daily by the courts in such frames of reference as negligence and scienter, and should be amenable to a case-by-case development. We believe that strict observance of the requirements laid down here will result in that uniformity and definiteness which Congress called for in the 1952 Act.

While we have focused attention on the appropriate standard to be applied by the courts, it must be remembered that the primary responsibility for sifting out unpatentable material lies in the Patent Office. To await litigation is - for all practical purposes - to debilitate the patent system. We have observed a notorious difference between the standards applied by the Patent Office and by the courts. While many reasons can be adduced to explain the discrepancy, one may well be the free rein often exercised by Examiners in their use of the concept of "invention." In this connection we note that the Patent Office is confronted with a most difficult task. Almost 100,000 applications for patents are filed each year. Of these, about 50,000 are granted and the backlog now runs well over 200,000. 1965 Annual Report of the Commissioner of Patents 13-14. This is itself a compelling reason for the Commissioner to strictly adhere to the 1952 Act as interpreted here. This would, we believe, not only expedite disposition but

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bring about a closer concurrence between administrative and judicial precedent.[Footnote 10]

Although we conclude here that the inquiry which the Patent Office and the courts must make as to patentability must be beamed with greater intensity on the requirements of 103, it bears repeating that we find no change in the general strictness with which the overall test is to be applied. We have been urged to find in 103 a relaxed standard, supposedly a congressional reaction to the "increased standard" applied by this Court in its decisions over the last 20 or 30 years. The standard has remained invariable in this Court. Technology, however, has advanced - and with remarkable rapidity in the last 50 years. Moreover, the ambit of applicable art in given fields of science has widened by disciplines unheard of a half century ago. It is but an evenhanded application to require that those persons granted the benefit of a patent monopoly be charged with an awareness of these changed

conditions. The same is true of the less technical, but still useful arts. He who seeks to build a better mousetrap today has a long path to tread before reaching the Patent Office.

VI.

We now turn to the application of the conditions found necessary for patentability to the cases involved here:

A. The Patent in Issue in No. 11, Graham v. John Deere Co.

This patent, No. 2,627,798 (hereinafter called the '798 patent) relates to a spring clamp which permits plow shanks to be pushed upward when they hit obstructions

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in the soil, and then springs the shanks back into normal position when the obstruction is passed over. The device, which we show diagrammatically in the accompanying sketches (Appendix, Fig. 1), is fixed to the plow frame as a unit. The mechanism around which the controversy centers is basically a hinge. The top half of it, known as the upper plate (marked 1 in the sketches), is a heavy metal piece clamped to the plow frame (2) and is stationary relative to the plow frame. The lower half of the hinge, known as the hinge plate (3), is connected to the rear of the upper plate by a hinge pin (4) and rotates downward with respect to it. The shank (5), which is bolted to the forward end of the hinge plate (at 6), runs beneath the plate and parallel to it for about nine inches, passes through a stirrup (7), and then continues backward for several feet curving down toward the ground. The chisel (8), which does the actual plowing, is attached to the rear end of the shank. As the plow frame is pulled forward, the chisel rips through the soil, thereby plowing it. In the normal position, the hinge plate and the shank are kept tight against the upper plate by a spring (9), which is atop the upper plate. A rod (10) runs through the center of the spring, extending down through holes in both plates and the shank. Its upper end is bolted to the top of the spring while its lower end is hooked against the underside of the shank.

When the chisel hits a rock or other obstruction in the soil, the obstruction forces the chisel and the rear portion of the shank to move upward. The shank is pivoted (at 11) against the rear of the hinge plate and pries open the hinge against the closing tendency of the spring. (See sketch labeled "Open Position," Appendix, Fig. 1.) This closing tendency is caused by the fact that, as the hinge is opened, the connecting rod is pulled downward and the spring is compressed. When the obstruction

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is passed over, the upward force on the chisel disappears and the spring pulls the shank and hinge plate back into their original position. The lower, rear portion of the hinge plate is constructed in the form of a stirrup (7) which brackets the shank, passing around and beneath it. The shank fits loosely into the stirrup (permitting a slight up and down play). The stirrup is designed to prevent the shank

from recoiling away from the hinge plate, and thus prevents excessive strain on the shank near its bolted connection. The stirrup also girds the shank, preventing it from fishtailing from side to side.

In practical use, a number of spring-hinge-shank combinations are clamped to a plow frame, forming a set of ground-working chisels capable of withstanding the shock of rocks and other obstructions in the soil without breaking the shanks.

Background of the Patent.

Chisel plows, as they are called, were developed for plowing in areas where the ground is relatively free from rocks or stones. Originally, the shanks were rigidly attached to the plow frames. When such plows were used in the rocky, glacial soils of some of the Northern States, they were found to have serious defects. As the chisels hit buried rocks, a vibratory motion was set up and tremendous forces were transmitted to the shank near its connection to the frame. The shanks would break. Graham, one of the petitioners, sought to meet that problem, and in 1950 obtained a patent, U.S. No. 2,493,811 (hereinafter '811), on a spring clamp which solved some of the difficulties. Graham and his companies manufactured and sold the '811 clamps. In 1950, Graham modified the '811 structure and filed for a patent. That patent, the one in issue, was granted in 1953. This suit against competing plow manufacturers resulted from charges by petitioners that several of respondents' devices infringed the '798 patent.

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The Prior Art.

Five prior patents indicating the state of the art were cited by the Patent Office in the prosecution of the '798 application. Four of these patents, 10 other United States patents and two prior-use spring-clamp arrangements not of record in the '798 file wrapper were relied upon by respondents as revealing the prior art. The District Court and the Court of Appeals found that the prior art "as a whole in one form or another contains all of the mechanical elements of the 798 Patent." One of the prior-use clamp devices not before the Patent Examiner - Glencoe - was found to have "all of the elements."

We confine our discussion to the prior patent of Graham, '811, and to the Glencoe clamp device, both among the references asserted by respondents. The Graham '811 and '798 patent devices are similar in all elements, save two: (1) the stirrup and the bolted connection of the shank to the hinge plate do not appear in '811; and (2) the position of the shank is reversed, being placed in patent '811 above the hinge plate, sandwiched between it and the upper plate. The shank is held in place by the spring rod which is hooked against the bottom of the hinge plate passing through a slot in the shank. Other differences are of no consequence to our examination. In practice the '811 patent arrangement permitted the shank to wobble or fishtail because it was not rigidly fixed to the hinge plate; moreover, as the hinge plate was below the shank, the latter caused wear on the upper plate, a member difficult to repair or replace.

Graham's '798 patent application contained 12 claims. All were rejected as not distinguished from the Graham '811 patent. The inverted position of the shank was specifically rejected as was the bolting of the shank to the hinge plate. The Patent Office examiner found these to be "matters of design well within the expected skill of

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the art and devoid of invention." Graham withdrew the original claims and substituted the two new ones which are substantially those in issue here. His contention was that wear was reduced in patent '798 between the shank and the heel or rear of the upper plate.[Footnote 11] He also emphasized several new features, the relevant one here being that the bolt used to connect the hinge plate and shank maintained the upper face of the shank in continuing and constant contact with the underface of the hinge plate.

Graham did not urge before the Patent Office the greater "flexing" qualities of the '798 patent arrangement which he so heavily relied on in the courts. The sole element in patent '798 which petitioners argue before us is the interchanging of the shank and hinge plate and the consequences flowing from this arrangement. The contention is that this arrangement - which petitioners claim is not disclosed in the prior art - permits the shank to flex under stress for its entire length. As we have sketched (see sketch, "Graham '798 Patent" in Appendix, Fig. 2), when the chisel hits an obstruction the resultant force (A) pushes the rear of the shank upward and the shank pivots against the rear of the hinge plate at (C). The natural tendency is for that portion of the shank between the pivot point and the bolted connection (i. e., between C and D) to bow downward and away from the hinge plate. The maximum distance

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(B) that the shank moves away from the plate is slight - for emphasis, greatly exaggerated in the sketches. This is so because of the strength of the shank and the short - nine inches or so - length of that portion of the shank between (C) and (D). On the contrary, in patent '811 (see sketch, "Graham '811 Patent" in Appendix, Fig. 2), the pivot point is the upper plate at point (c); and while the tendency for the shank to bow between points (c) and (d) is the same as in '798, the shank is restricted because of the underlying hinge plate and cannot flex as freely. In practical effect, the shank flexes only between points (a) and (c), and not along the entire length of the shank, as in '798. Petitioners say that this difference in flex, though small, effectively absorbs the tremendous forces of the shock of obstructions whereas prior art arrangements failed.

The Obviousness of the Differences.

We cannot agree with petitioners. We assume that the prior art does not disclose such an arrangement as petitioners claim in patent '798. Still we do not believe that the argument on which petitioners' contention is bottomed supports the validity of the patent. The tendency of the shank to flex is the same in all cases. If free-flexing, as petitioners now argue, is the crucial difference above the prior art,

then it appears evident that the desired result would be obtainable by not boxing the shank within the confines of the hinge.[Footnote 12] The only other effective place available in the arrangement was to attach it below the hinge plate and run it through a

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stirrup or bracket that would not disturb its flexing qualities. Certainly a person having ordinary skill in the prior art, given the fact that the flex in the shank could be utilized more effectively if allowed to run the entire length of the shank, would immediately see that the thing to do was what Graham did, i. e., invert the shank and the hinge plate.

Petitioners' argument basing validity on the free-flex theory raised for the first time on appeal is reminiscent of Lincoln Engineering Co. v. Stewart-Warner Corp., 303 U.S. 545 (1938), where the Court called such an effort "an afterthought. No such function . . . is hinted at in the specifications of the patent. If this were so vital an element in the functioning of the apparatus it is strange that all mention of it was omitted." At p. 550. No "flexing" argument was raised in the Patent Office. Indeed, the trial judge specifically found that "flexing is not a claim of the patent in suit . . ." and would not permit interrogation as to flexing in the accused devices. Moreover, the clear testimony of petitioners' experts shows that the flexing advantages flowing from the '798 arrangement are not, in fact, a significant feature in the patent.[Footnote 13]

We find no nonobvious facets in the '798 arrangement. The wear and repair claims were sufficient to overcome

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the patent examiner's original conclusions as to the validity of the patent. However, some of the prior art, notably Glencoe, was not before him. There the hinge plate is below the shank but, as the courts below found, all of the elements in the '798 patent are present in the Glencoe structure. Furthermore, even though the position of the shank and hinge plate appears reversed in Glencoe, the mechanical operation is identical. The shank there pivots about the underside of the stirrup, which in Glencoe is above the shank. In other words, the stirrup in Glencoe serves exactly the same function as the heel of the hinge plate in '798. The mere shifting of the wear point to the heel of the '798 hinge plate from the stirrup of Glencoe - itself a part of the hinge plate - presents no operative mechanical distinctions, much less nonobvious differences.

B. The Patent in Issue in No. 37, Calmar, Inc. v. Cook Chemical Co., and in No. 43, Colgate-Palmolive Co. v. Cook Chemical Co.

The single patent[Footnote 14] involved in these cases relates to a plastic finger sprayer with a "hold-down" lid used as a built-in dispenser for containers or bottles packaging liquid products, principally household insecticides. Only the first two of the four claims in the patent are involved here and we,

therefore, limit our discussion to them. We do not set out those claims here since they are printed in 220 F. Supp., at 417-418.

In essence the device here combines a finger-operated pump sprayer, mounted in a container or bottle by means of a container cap, with a plastic overcap which screws over the top of and depresses the sprayer (see Appendix,

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Fig. 3). The pump sprayer passes through the container cap and extends down into the liquid in the container; the overcap fits over the pump sprayer and screws down on the outside of a collar mounting or retainer which is molded around the body of the sprayer. When the overcap is screwed down on this collar mounting a seal is formed by the engagement of a circular ridge or rib located above the threads on the collar mounting with a mating shoulder located inside the overcap above its threads.[Footnote 15] The overcap, as it is screwed down, depresses the pump plunger rendering the pump inoperable and when the seal is effected, any liquid which might seep into the overcap through or around the pump is prevented from leaking out of the overcap. The overcap serves also to protect the sprayer head and prevent damage to it during shipment or merchandising. When the overcap is in place it does not reach the cap of the container or bottle and in no way engages it since a slight space is left between those two pieces.

The device, called a shipper-sprayer in the industry, is sold as an integrated unit with the overcap in place enabling the insecticide manufacturer to install it on the container or bottle of liquid in a single operation in an automated bottling process. The ultimate consumer simply unscrews and discards the overcap, the pump plunger springs up and the sprayer is ready for use.

The Background of the Patent.

For many years manufacturers engaged in the insecticide business had faced a serious problem in developing sprayers that could be integrated with the containers or bottles in which the insecticides were marketed. Originally, insecticides were applied through the use of tin

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sprayers, not supplied by the manufacturer. In 1947, Cook Chemical, an insecticide manufacturer, began to furnish its customers with plastic pump dispensers purchased from Calmar. The dispenser was an unpatented finger-operated device mounted in a perforated cardboard holder and hung over the neck of the bottle or container. It was necessary for the ultimate consumer to remove the cap of the container and insert and attach the sprayer to the latter for use.

Hanging the sprayer on the side of the container or bottle was both expensive and troublesome. Packaging for shipment had to be a hand operation, and breakage and pilferage as well as the loss of the sprayer during shipment and retail display often occurred. Cook Chemical urged Calmar to develop

an integrated sprayer that could be mounted directly in a container or bottle during the automated filling process and that would not leak during shipment or retail handling. Calmar did develop some such devices but for various reasons they were not completely successful. The situation was aggravated in 1954 by the entry of Colgate-Palmolive into the insecticide trade with its product marketed in aerosol spray cans. These containers, which used compressed gas as a propellent to dispense the liquid, did not require pump sprayers.

During the same year Calmar was acquired by the Drackett Company. Cook Chemical became apprehensive of its source of supply for pump sprayers and decided to manufacture its own through a subsidiary, Bakan Plastics, Inc. Initially, it copied its design from the unpatented Calmar sprayer, but an officer of Cook Chemical, Scoggin, was assigned to develop a more efficient device. By 1956 Scoggin had perfected the shipper-sprayer in suit and a patent was granted in 1959 to Cook Chemical as his assignee. In the interim Cook Chemical began to use Scoggin's device and also marketed

it to the trade. The device was well received and soon became widely used.

In the meanwhile, Calmar employed two engineers, Corsette and Cooprider, to perfect a shipper-sprayer and by 1958 it began to market its SS-40, a device very much similar to Scoggin's. When the Scoggin patent issued, Cook Chemical charged Calmar's SS-40 with infringement and this suit followed.

The Opinions of the District Court and the Court of Appeals.

At the outset it is well to point up that the parties have always disagreed as to the scope and definition of the invention claimed in the patent in suit. Cook Chemical contends that the invention encompasses a unique combination of admittedly old elements and that patentability is found in the result produced. Its expert testified that the invention was "the first commercially successful, inexpensive integrated shipping closure pump unit which permitted automated assembly with a container of household insecticide or similar liquids to produce a practical, ready-to-use package which could be shipped without external leakage and which was so organized that the pump unit with its hold-down cap could be itself assembled and sealed and then later assembled and sealed on the container without breaking the first seal." Cook Chemical stresses the long-felt need in the industry for such a device; the inability of others to produce it; and its commercial success - all of which, contends Cook, evidences the nonobvious nature of the device at the time it was developed. On the other hand, Calmar says that the differences between Scoggin's shipper-sprayer and the prior art relate only to the design of the overcap and that the differences are so inconsequential that the device as a whole would have been obvious at the time of its invention to a person having ordinary skill in the art.

Both courts accepted Cook Chemical's contentions. While the exact basis of the District Court's holding is uncertain, the court did find the subject matter of the patent new, useful and nonobvious. It concluded that Scoggin "had produced a sealed and protected sprayer unit which the manufacturer need only screw onto the top of its container in much the same fashion as a simple metal cap." 220 F. Supp., at 418. Its decision seems to be bottomed on the finding that the Scoggin sprayer solved the long-standing problem that had confronted the industry.[Footnote 16] The Court of Appeals also found validity in the "novel `marriage' of the sprayer with the insecticide container" which took years in discovery and in "the immediate commercial success" which it enjoyed. While finding that the individual elements of the invention were "not novel per se" the court found "nothing in the prior art suggesting Scoggin's unique combination of these old features . . . as would solve the . . . problems which for years beset the insecticide industry." It concluded that "the . . . [device] meets the exacting standard required for a combination of old elements to rise to the level of patentable invention by fulfilling the long-felt need with an economical, efficient, utilitarian apparatus which achieved novel results and immediate commercial success." 336 F.2d, at 114.

The Prior Art.

Only two of the five prior art patents cited by the Patent Office Examiner in the prosecution of Scoggin's application are necessary to our discussion, i. e., Lohse

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U.S. Patent No. 2,119,884 (1938) and Mellon U.S. Patent No. 2,586,687 (1952). Others are cited by Calmar that were not before the Examiner, but of these our purposes require discussion of only the Livingstone U.S. Patent No. 2,715,480 (1953). Simplified drawings of each of these patents are reproduced in the Appendix, Figs. 4-6, for comparison and description.

The Lohse patent (Fig. 4) is a shipper-sprayer designed to perform the same function as Scoggin's device. The differences, recognized by the District Court, are found in the overcap seal which in Lohse is formed by the skirt of the overcap engaging a washer or gasket which rests upon the upper surface of the container cap. The court emphasized that in Lohse "[t]here are no seals above the threads and below the sprayer head." 220 F. Supp., at 419.

The Mellon patent (Fig. 5), however, discloses the idea of effecting a seal above the threads of the overcap. Mellon's device, likewise a shipper-sprayer, differs from Scoggin's in that its overcap screws directly on the container, and a gasket, rather than a rib, is used to effect the seal.

Finally, Livingstone (Fig. 6) shows a seal above the threads accomplished without the use of a gasket or washer.[Footnote 17] Although Livingstone's arrangement was designed to cover and protect pouring spouts, his sealing feature is strikingly similar to Scoggin's. Livingstone uses a tongue and groove technique in which the tongue, located on the upper surface of the collar, fits into a groove on the inside of the overcap. Scoggin employed the rib and shoulder seal in the identical position and with less efficiency because the Livingstone technique

is inherently a more stable structure, forming an interlock that withstands distortion of the overcap when subjected to rough handling. Indeed, Cook Chemical has now incorporated the Livingstone closure into its own shipper-sprayers as had Calmar in its SS-40.

The Invalidity of the Patent.

Let us first return to the fundamental disagreement between the parties. Cook Chemical, as we noted at the outset, urges that the invention must be viewed as the overall combination, or - putting it in the language of the statute - that we must consider the subject matter sought to be patented taken as a whole. With this position, taken in the abstract, there is, of course, no quibble. But the history of the prosecution of the Scoggin application in the Patent Office reveals a substantial divergence in respondent's present position.

As originally submitted, the Scoggin application contained 15 claims which in very broad terms claimed the entire combination of spray pump and overcap. No mention of, or claim for, the sealing features was made. All 15 claims were rejected by the Examiner because (1) the applicant was vague and indefinite as to what the invention was, and (2) the claims were met by Lohse. Scoggin canceled these claims and submitted new ones. Upon a further series of rejections and new submissions, the Patent Office Examiner, after an office interview, at last relented. It is crystal clear that after the first rejection, Scoggin relied entirely upon the sealing arrangement as the exclusive patentable difference in his combination. It is likewise clear that it was on that feature that the Examiner allowed the claims. In fact, in a letter accompanying the final submission of claims, Scoggin, through his attorney, stated that "agreement was reached between the Honorable Examiner and applicant's attorney relative to limitations which must be in the claims in

order to define novelty over the previously applied disclosure of Lohse when considered in view of the newly cited patents of Mellon and Darley, Jr." (Italics added.)

Moreover, those limitations were specifically spelled out as (1) the use of a rib seal and (2) an overcap whose lower edge did not contact the container cap. Mellon was distinguished, as was the Darley patent, infra, n. 18, on the basis that although it disclosed a hold-down cap with a seal located above the threads, it did not disclose a rib seal disposed in such position as to cause the lower peripheral edge of the overcap "to be maintained out of contacting relationship with [the container] cap . . . when . . . [the overcap] was screwed [on] tightly . . . ." Scoggin maintained that the "obvious modification" of Lohse in view of Mellon would be merely to place the Lohse gasket above the threads with the lower edge of the overcap remaining in tight contact with the container cap or neck of the container itself. In other words, the Scoggin invention was limited to the use of a rib - rather than a washer or gasket - and the existence of a slight space between the overcap and the container cap.

It is, of course, well settled that an invention is construed not only in the light of the claims, but also with reference to the file wrapper or prosecution history in the Patent Office. Hogg v. Emerson, 11 How. 587 (1850); Crawford v. Heysinger, 123 U.S. 589 (1887). Claims as allowed must be read and interpreted with reference to rejected ones and to the state of the prior art; and claims that have been narrowed in order to obtain the issuance of a patent by distinguishing the prior art cannot be sustained to cover that which was previously by limitation eliminated from the patent. Powers-Kennedy Co. v. Concrete Co., 282 U.S. 175, 185-186 (1930); Schriber Co. v. Cleveland Trust Co., 311 U.S. 211, 220-221 (1940).

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Here, the patentee obtained his patent only by accepting the limitations imposed by the Examiner. The claims were carefully drafted to reflect these limitations and Cook Chemical is not now free to assert a broader view of Scoggin's invention. The subject matter as a whole reduces, then, to the distinguishing features clearly incorporated into the claims. We now turn to those features.

As to the space between the skirt of the overcap and the container cap, the District Court found:

> "Certainly without a space so described, there could be no inner seal within the cap, but such a space is not new or novel, but it is necessary to the formation of the seal within the hold-down cap.
> "To me this language is descriptive of an element of the patent but not a part of the invention. It is too simple, really, to require much discussion. In this device the hold-down cap was intended to perform two functions - to hold down the sprayer head and to form a solid tight seal between the shoulder and the collar below. In assembling the element it is necessary to provide this space in order to form the seal." 220 F. Supp., at 420. (Italics added.)

The court correctly viewed the significance of that feature. We are at a loss to explain the Examiner's allowance on the basis of such a distinction. Scoggin was able to convince the Examiner that Mellon's cap contacted the bottle neck while his did not. Although the drawings included in the Mellon application show that the cap might touch the neck of the bottle when fully screwed down, there is nothing - absolutely nothing - which indicates that the cap was designed at any time to engage the bottle neck. It is palpably evident that Mellon embodies a seal formed by a gasket compressed

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between the cap and the bottle neck. It follows that the cap in Mellon will not seal if it does not bear down on the gasket and this would be impractical, if not impossible, under the construction urged by Scoggin before the Examiner. Moreover, the space so strongly asserted by Cook Chemical appears quite plainly on the Livingstone device, a reference not cited by the Examiner.

The substitution of a rib built into a collar likewise presents no patentable difference above the prior art. It was fully disclosed and dedicated to the public in the Livingstone patent. Cook Chemical argues,

however, that Livingstone is not in the pertinent prior art because it relates to liquid containers having pouring spouts rather than pump sprayers. Apart from the fact that respondent made no such objection to similar references cited by the Examiner,[Footnote 18] so restricted a view of the applicable prior art is not justified. The problems confronting Scoggin and the insecticide industry were not insecticide problems; they were mechanical closure problems. Closure devices in such a closely related art as pouring spouts for liquid containers are at the very least pertinent references. See, II Walker on Patents 260 (Deller ed. 1937).

Cook Chemical insists, however, that the development of a workable shipper-sprayer eluded Calmar, who had long and unsuccessfully sought to solve the problem. And, further, that the long-felt need in the industry for a device such as Scoggin's together with its wide commercial success supports its patentability. These legal inferences

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or subtests do focus attention on economic and motivational rather than technical issues and are, therefore, more susceptible of judicial treatment than are the highly technical facts often present in patent litigation. See Judge Learned Hand in Reiner v. I. Leon Co., 285 F.2d 501, 504 (1960). See also Note, Subtests of "Nonobviousness": A Nontechnical Approach to Patent Validity, 112 U. Pa. L. Rev. 1169 (1964). Such inquiries may lend a helping hand to the judiciary which, as Mr. Justice Frankfurter observed, is most ill-fitted to discharge the technological duties cast upon it by patent legislation. Marconi Wireless Co. v. United States, 320 U.S. 1, 60 (1943). They may also serve to "guard against slipping into use of hindsight," Monroe Auto Equipment Co. v. Heckethorn Mfg. & Sup. Co., 332 F.2d 406, 412 (1964), and to resist the temptation to read into the prior art the teachings of the invention in issue.

However, these factors do not, in the circumstances of this case, tip the scales of patentability. The Scoggin invention, as limited by the Patent Office and accepted by Scoggin, rests upon exceedingly small and quite nontechnical mechanical differences in a device which was old in the art. At the latest, those differences were rendered apparent in 1953 by the appearance of the Livingstone patent, and unsuccessful attempts to reach a solution to the problems confronting Scoggin made before that time became wholly irrelevant. It is also irrelevant that no one apparently chose to avail himself of knowledge stored in the Patent Office and readily available by the simple expedient of conducting a patent search - a prudent and nowadays common preliminary to well organized research. Mast, Foos & Co. v. Stover Mfg. Co., 177 U.S. 485 (1900). To us, the limited claims of the Scoggin patent are clearly evident from the prior art as it stood at the time of the invention.

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We conclude that the claims in issue in the Scoggin patent must fall as not meeting the test of 103, since the differences between them and the pertinent prior art would have been obvious to a person reasonably skilled in that art.

The judgment of the Court of Appeals in No. 11 is affirmed. The judgment of the Court of Appeals in Nos. 37 and 43 is reversed and the cases remanded to the District Court for disposition not inconsistent with this opinion.

It is so ordered.

MR. JUSTICE STEWART took no part in the consideration or decision of Nos. 37 and 43.

MR. JUSTICE FORTAS took no part in the consideration or decision of these cases.

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Footnotes

Footnote 1 The provision appears in the Constitution spliced together with the copyright provision, which we omit as not relevant here. See H. R. Rep. No. 1923, 82d Cong., 2d Sess., at 4 (1952); DeWolf, An Outline of Copyright Law, p. 15 (Boston, 1925).

Footnote 2 "Stable ownership is the gift of social law, and is given late in the progress of society. It would be curious then, if an idea, the fugitive fermentation of an individual brain, could, of natural right, be claimed in exclusive and stable property. If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea, which an individual may exclusively possess as long as he keeps it to himself; but the moment it is divulged, it forces itself into the possession of every one, and the receiver cannot dispossess himself of it. Its peculiar character, too, is that no one possesses the less, because every other possesses

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the whole of it. He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me. That ideas should freely spread from one to another over the globe, for the moral and mutual instruction of man, and improvement of his condition, seems to have been peculiarly and benevolently designed by nature, when she made them, like fire, expansible over all space, without lessening their density in any point, and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation. Inventions then cannot, in nature, be a subject of property. Society may give an exclusive right to the profits arising from them, as an encouragement to men to pursue ideas which may produce utility, but this may or may not be done, according to the will and convenience of the society, without claim or complaint from any body." VI Writings of Thomas Jefferson, at 180-181 (Washington ed.).

Footnote 3 "[A] machine of which we are possessed, might be applied by every man to any use of which it is susceptible." Letter to Isaac McPherson, supra, at 181. "[A] change of material should not give title to a patent. As the making a ploughshare of cast rather than of wrought iron; a comb of iron

instead of horn or of ivory . . . ." Ibid. "[A] mere change of form should give no right to a patent, as a high-quartered shoe instead of a low one; a round hat instead of a three-square; or a square bucket instead of a round one." Id., at 181-182. "[A combined use of old implements.] A man has a right to use a saw, an axe, a plane separately; may he not combine their uses on the same piece of wood?" Letter to Oliver Evans (Jan. 1814), VI Writings of Thomas Jefferson, at 298 (Washington ed.).

Footnote 4 In historical retrospect, the specific result in Hotchkiss flows directly from an application of one of the rules of the original board of "Commissioners," n. 3, second rule, supra.

Footnote 5 " 101. Inventions patentable "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." " 102. Conditions for patentability; novelty and loss of right to patent "A person shall be entitled to a patent unless - "(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or "(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in

this country, more than one year prior to the date of the application for patent in the United States, or "(c) he has abandoned the invention, or "(d) the invention was first patented or caused to be patented by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application filed more than twelve months before the filing of the application in the United States, or "(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or "(f) he did not himself invent the subject matter sought to be patented, or "(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other." The precursors of these sections are to be found in the Act of February 21, 1793, c. 11, 1 Stat. 318; Act of July 4, 1836, c. 357, 5 Stat. 117; Act of July 8, 1870, c. 230, 16 Stat. 198; Rev. Stat. 4886 (1874).

Footnote 6 The corresponding provision in the preliminary draft was titled "Conditions for patentability, lack of invention" (italics added), Proposed Revision and Amendment of the Patent Laws, Preliminary Draft with Notes, House Committee on the Judiciary (Committee Print, 1950).

Footnote 7 The sentence in which the phrase occurs reads: "[T]he new device, however useful it may be, must reveal the flash of creative genius, not merely the skill of the calling." At p. 91. Although some writers and lower courts found in the language connotations as to the frame of mind of the inventors, none were so intended. The opinion approved Hotchkiss specifically, and the reference to "flash of

creative genius" was but a rhetorical embellishment of language going back to 1833. Cf. "exercise of genius," Shaw v. Cooper, 7 Pet. 292; "inventive genius," Reckendorfer v. Faber, 92 U.S. 347 (1876); Concrete Appliances Co. v. Gomery, 269 U.S. 177; "flash of thought," Densmore v. Scofield, 102 U.S. 375 (1880); "intuitive genius," Potts v. Creager, 155 U.S. 597 (1895). Rather than establishing a more exacting standard, Cuno merely rhetorically restated the requirement that the subject matter sought to be patented must be beyond the skill of the calling. It was the device, not

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the invention, that had to reveal the "flash of creative genius." See Boyajian, The Flash of Creative Genius, An Alternative Interpretation, 25 J. Pat. Off. Soc. 776, 780, 781 (1943); Pacific Contact Laboratories, Inc. v. Solex Laboratories, Inc., 209 F.2d 529, 533; Brown & Sharpe Mfg. Co. v. Kar Engineering Co., 154 F.2d 48, 51-52; In re Shortell, 31 C. C. P. A. (Pat.) 1062, 1069, 142 F.2d 292, 295-296.

Footnote 8 "There is no provision corresponding to the first sentence explicitly stated in the present statutes, but the refusal of patents by the Patent Office, and the holding of patents invalid by the courts, on the ground of lack of invention or lack of patentable novelty has been followed since at least as early as 1850. This paragraph is added with the view that an explicit statement in the statute may have some stabilizing effect, and also to serve as a basis for the addition at a later time of some criteria which may be worked out. "The second sentence states that patentability as to this requirement is not to be negatived by the manner in which the invention was made, that is, it is immaterial whether it resulted from long toil and experimentation or from a flash of genius."

Footnote 9 See Efforts to Establish a Statutory Standard of Invention, Study No. 7, Senate Subcommittee on Patents, Trademarks, and Copyrights, 85th Cong., 1st Sess. (Committee Print, 1958); Hearings, Subcommittee No. 3, House Committee on the Judiciary, on H. R. 3760, 82d Cong., 1st Sess. (1951).

Footnote 10 The President has appointed a Commission on the Patent System. Executive Order No. 11215, 30 Fed. Reg. 4661 (April 10, 1965). It is hoped that its studies may develop more efficient administrative procedures and techniques that will further expedite dispositions and at the same time insure the strict application of appropriate tests of patentability.

Footnote 11 In '811, where the shank was above the hinge plate, an upward movement of the chisel forced the shank up against the underside of the rear of the upper plate. The upper plate thus provided the fulcrum about which the hinge was pried open. Because of this, as well as the location of the hinge pin, the shank rubbed against the heel of the upper plate causing wear both to the plate and to the shank. By relocating the hinge pin and by placing the hinge plate between the shank and the upper plate, as in '798, the rubbing was eliminated and the wear point was changed to the hinge plate, a member more easily removed or replaced for repair.

Footnote 12 Even petitioners' expert testified to that effect: "Q. Given the same length of the forward portion of the clamp . . . you would anticipate that the magnitude of flex [in '798] would be precisely the same or substantially the same as in 811, wouldn't you? "A. I would think so."

Footnote 13 "Q. . . . Do you regard the small degree of flex in the forward end of the shank that lies between the pivot point and the point of spring attachment to be of any significance or any importance to the functioning of a device such as 798? A. Unless you are approaching the elastic limit, I think this flexing will reduce the maximum stress at the point of pivot there, where the maximum stress does occur. I think it will reduce that. I don't know how much. "Q. Do you think it is a substantial factor, a factor of importance in the functioning of the structure? A. Not a great factor, no." The same expert previously testified similarly in Jeoffroy Mfg., Inc. v. Graham, 219 F.2d 511.

Footnote 14 The patent is U.S. No. 2,870,943 issued in 1959 to Cook Chemical Co. as assignee of Baxter I. Scoggin, Jr., the inventor. In No. 37, Calmar is the manufacturer of an alleged infringing device, and, in No. 43, Colgate is a customer of Calmar and user of its device.

Footnote 15 Our discussion here relates to the overcap seal. The container itself is sealed in the customary way through the use of a container gasket located between the container and the container cap.

Footnote 16 "By the same reasoning, may it not also be said that if [the device] solved a long-sought need, it was likewise novel? If it meets the requirements of being new, novel and useful, it was the subject of invention, although it may have been a short step, nevertheless it was the last step that ended the journey. The last step is the one that wins and he who takes it when others could not, is entitled to patent protection." 220 F. Supp., at 421.

Footnote 17 While the sealing feature was not specifically claimed in the Livingstone patent, it was disclosed in the drawings and specifications. Under long-settled law the feature became public property. Miller v. Brass Co., 104 U.S. 350, 352 (1882).

Footnote 18 In addition to Livingstone and Mellon, the Examiner cited Slade, U.S. Patent No. 2,844,290 (hold-down cap for detergent cans having a pouring spout); Nilson, U.S. Patent No. 2,118,222 (combined cap and spout for liquid dispensing containers); Darley, Jr., U.S. Patent No. 1,447,712 (containers for toothpaste, cold creams and other semi-liquid substances).

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix F

MPEP 804.02 Avoiding a Double Patenting Rejection - II.NONSTATUTORY

A rejection based on a nonstatutory type of double patenting can be avoided by filing a terminal disclaimer in the application or proceeding in which the rejection is made. *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Knohl*, 386 F.2d 476, 155 USPQ 586 (CCPA 1967); and *In re Griswold*, 365 F.2d 834, 150 USPQ 804 (CCPA 1966). The use of a terminal disclaimer in overcoming a nonstatutory double patenting rejection is in the public interest because it encourages the disclosure of additional developments, the earlier filing of applications, and the earlier expiration of patents whereby the inventions covered become freely available to the public. *In re Jentoft*, 392 F.2d 633, 157 USPQ 363 (CCPA 1968); *In re Eckel*, 393 F.2d 848, 157 USPQ 415 (CCPA 1968); and *In re Braithwaite*, 379 F.2d 594, 154 USPQ 29 (CCPA 1967).

The use of a 37 CFR 1.131 affidavit in overcoming a double patenting rejection is inappropriate because the claim or claims in the application are being rejected over a patent which claims the rejected invention. *In re Dunn*, 349 F.2d 433, 146 USPQ 479 (CCPA 1965). 37 CFR 1.131 is inapplicable if the claims of the application and the patent are "directed to substantially the same invention." It is also inapplicable if there is a lack of "patentable distinctness" between the claimed subject matter. *Knell v. Muller*, 174 USPQ 460 (Comm'r. Pat. 1971), citing the court decisions in *In re Ward*, 236 F.2d 428, 111 USPQ 101 (CCPA 1956); *In re Teague*, 254 F.2d 145, 117 USPQ 284 (CCPA 1958); and *In re Hidy*, 303 F.2d 954, 133 USPQ 65 (CCPA 1962).

A patentee or applicant may disclaim or dedicate to the public the entire term, or any terminal part of the term of a patent. 35 U.S.C. 253. The statute does not provide for a terminal disclaimer of only a specified claim or claims. The terminal disclaimer must operate with respect to all claims in the patent.

The filing of a terminal disclaimer to obviate a rejection based on nonstatutory double patenting is not an admission of the propriety of the rejection. *Quad Environmental Technologies Corp. v. Union Sanitary District*, 946 F.2d 870, 20 USPQ2d 1392 (Fed. Cir. 1991). The court indicated that the "filing of a terminal disclaimer simply serves the statutory function of removing the rejection of double patenting, and raises neither a presumption nor estoppel on the merits of the rejection."

A terminal disclaimer filed to obviate a double patenting rejection is effective only with respect to the application identified in the disclaimer, unless by its terms it extends to continuing applications. If an appropriate >"provisional" nonstatutory< double patenting rejection ** is made in >each of< two or more pending applications, **>the examiner should follow the practice set forth in MPEP § 804, subsection I.B.1. in determining in which of the applications an appropriate terminal disclaimer must be filed. Claims that differ from each other (aside from minor differences in language, punctuation, etc.), whether or not the difference *>would have been<obvious, are not considered to be drawn to the same invention for double patenting purposes under 35 U.S.C. 101. In cases where the difference in claims *>would have been< obvious, terminal disclaimers are effective to overcome double patenting rejections. *>Where the subject matter of the reference and the claimed invention were commonly owned at the time the invention was made<, such terminal disclaimers must include a provision that the patent shall be unenforceable if it ceases to be commonly owned with the other application or patent. Note 37 CFR 1.321(c). >37 CFR 1.321(d) sets forth the requirements for a terminal disclaimer where the claimed invention resulted from activities undertaken within the scope of a joint research agreement as defined in 35 U.S.C. 103(c)(3).< It should be emphasized that a terminal disclaimer cannot be used to overcome a rejection under 35 U.S.C. 102(e)/103(a).

EVIDENCE APPENDIX (37CFR § 41.37(c)(1)(ix))

Appendix G

Terminal Disclaimer

PTO/SB/25 (09-06)
Approved for use through 03/31/2007. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION

Docket Number (Optional)
81131517 (19278)

In re Application of: Youngpeter, Bryan, et al

Application No.: 10/631,129

Filed: July 31, 2003

For: Power Steering Pump Having Electronic Bypass Control

The owner*, Automotive Components Holdings, LLC, of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending **reference** Application Number 10/631,363, filed on July 31, 2003, as such term is defined in 35 U.S.C. 154 and 173, and as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending **reference** application. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the **reference** application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of any patent granted on said **reference** application, "as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending **reference** application," in the event that: any such patent: granted on the pending **reference** application: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer filed prior to its grant.

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1. ☐ For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2. ☑ The undersigned is an attorney or agent of record. Reg. No. 31123

Mark L Mollon — Signature
4/3/07 — Date

Mark L. Mollon
Typed or printed name

734-542-0900
Telephone Number

☐ Terminal disclaimer fee under 37 CFR 1.20(d) is included.

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